Draft Remedy Selection Report

Plant Yates AP-3, A, B, B', and R6 CCR Landfill
708 Dyer Road
Newnan, Georgia

August 31, 2022

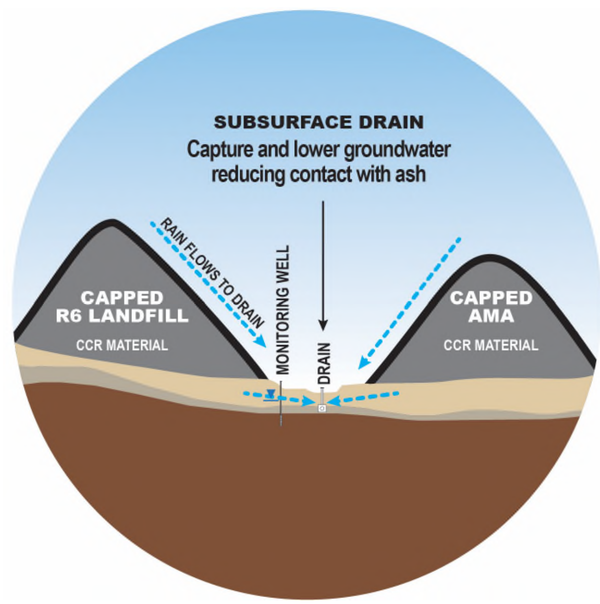
Georgia Power

Executive Summary

Plant Yates, located in Newnan, Georgia, originally operated seven coal-fired steam-generating units. Five of the units were retired in 2015 and two units were converted from coal to natural gas. Coal combustion residuals (CCR), commonly referred to as "coal ash", a non-hazardous material generated from burning coal to generate electricity, were stored at the site in ash ponds AP-3, A, B, and B' (AMA) and the R6 Landfill. Ash ponds were designed, installed, and operated to function as a treatment system for power plant wastewaters, and they have effectively served in this capacity for decades in compliance with the National Pollutant Discharge Elimination System ("NPDES") permits under which they were regulated. Georgia Power has undertaken actions to close the AMA and R6 Landfill in accordance with federal and state regulations. Ash pond consolidation and closure activities began in 2014 and are expected to conclude in early 2023. As part of a comprehensive approach to managing CCR, Georgia Power completed a detailed evaluation of corrective measures to remove selenium in groundwater above the Groundwater Protection Standard (GWPS) at the AMA and R6 CCR Landfill at Plant Yates.

Closure of the CCR Units

Source control by closure of the CCR unit provides considerable benefits to groundwater and is an important step in managing impacts to groundwater. Source control benefits are being achieved at Plant Yates through several steps in accordance with the performance standards applicable to CCR unit closures:



- **CCR consolidation:** AP-A and AP-B are being closed by removal with consolidation of CCR from those impoundments to the AMA.
- **Capping:** The AMA and R6 Landfills are being closed in place by capping with final cover systems.
- **Subsurface Drain:** The subsurface drain engineering measure and associated risers and pumps are designed to lower and sustain a lowered groundwater elevation relative to the elevation of the CCR closed in place.

Groundwater Monitoring and Assessment

Georgia Power has performed CCR groundwater monitoring at AMA and R6 since 2016. Over the period of Georgia Power's monitoring, concentrations of selenium were identified above GWPS in two downgradient wells. Extended groundwater monitoring indicates selenium above the GWPS is limited in extent (delineated) and confined to two wells well within the plant's property boundary.

Executive Summary

Risk Evaluation for Human Health and Environment

Georgia Power completed a risk evaluation on selenium in groundwater at the site. As documented in the Risk Evaluation Report, the selenium in groundwater at the site is not expected to pose a risk to human health or the environment.

Proposed Corrective Action for Groundwater: Monitored Natural Attenuation

Georgia Power submitted an assessment of corrective measures (ACM) report for AMA and R6 Landfill in June 2019. Georgia Power has worked with GA EPD to adhere to regulations and select a comprehensive and technically sound approach for implementing corrective measures to address selenium in groundwater. In light of the expected source control benefits, as a polishing step for selenium in groundwater, Monitored Natural Attenuation (MNA) was selected as the proposed remedy using the criteria described in the CCR Rule, 40 Code of Federal Regulations (CFR) Parts 257.97. MNA is the proposed remedy based on the site-specific demonstration following the EPA 2015 guidance of natural attenuation mechanisms, capacity, stability, and favorable protectiveness, effectiveness, and ease of implementation. The source control provided by the closure and MNA actions are anticipated to decrease selenium concentrations to less than the GWPS at the waste boundary within 10 years.

Adaptive Site Management

The remedy performance will be monitored, evaluated, and, if needed, the remedy will be adjusted or augmented to meet remedial objectives.

Long-term Groundwater Monitoring

Georgia Power will continue to perform groundwater monitoring and reporting at the AMA and R6 landfills for at least 30-years after the units are closed.

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Certification

I, Geoffrey Gay, am a professional engineer and licensed in the State of Georgia. I hereby certify that this Draft Remedy Selection Report was prepared by, or under the direct supervision of, a Qualified Groundwater Scientist, in accordance with the Georgia Environmental Protection Division (EPD) Rules of Solid Waste Management. According to 391-3-4-.01, a Qualified Groundwater Scientist is "a professional engineer or geologist registered to practice in Georgia who has received a baccalaureate or post-graduate degree in the natural sciences or engineering and has sufficient training and experience in groundwater hydrology and related fields that enable individuals to make sound professional judgments regarding groundwater monitoring, contaminant fate and transport, and corrective action." By affixing my professional seal and signature, I hereby acknowledge that this report has been prepared in conformance with the United States Environmental Protection Agency coal combustion residual rule [40 Code of Federal Regulations (CFR) 257 Subpart D] and the Georgia Environmental Protection Division Rules for Solid Waste Management 391-3-4-.10.

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Acronyms and Abbreviations

ACC	Atlantic Coast Consulting
ACM	assessment of corrective measures
AMA	Ash Management Area
AP	Ash Pond
AP-3	Ash Pond 3
AP-A	Ash Pond A
AP-B	Ash Pond B
AP-B’	Ash Pond B’
Arcadis	Arcadis U.S., Inc.
bgs	below ground surface
CCR	coal combustion residuals
CFR	Code of Federal Regulations
CSM	conceptual site model
GA EPD	Georgia Environmental Protection Division
Georgia Power	Georgia Power Company
GWPS	Groundwater Protection Standards
ISI	In-Situ Injections
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MNA	Monitored Natural Attenuation
redox	oxidation-reduction
SSL	statistically significant level
USEPA	United States Environmental Protection Agency
ZVI	zero-valent iron

1 Introduction

On behalf of Georgia Power Company (Georgia Power), Arcadis U.S., Inc. (Arcadis) prepared this Draft Remedy Selection Report for Plant Yates Ash Ponds (AP) AP-3, A, B, and B' and R6 CCR Landfill (the site). As documented here, Georgia Power has completed a detailed evaluation of corrective measures to address selenium in groundwater at statistically significant levels (SSLs) above the Groundwater Protection Standard (GWPS). The evaluation was completed in accordance with the United States Environmental Protection Agency's (USEPA's) Coal Combustion Residuals (CCR) Rule, 40 Code of Federal Regulations (CFR) Part 257 effective October 19, 2015 (CCR Rule) including subsequent revisions, and Georgia Environmental Protection Division's (GA EPD's) Rule for Solid Waste Management Rule 391-3-4-.10 for CCR.

This Draft Remedy Selection Report includes an overview of ongoing geologic and hydrogeologic investigations to refine the conceptual site model (CSM), identifies Appendix IV constituents detected in groundwater at SSLs above the GWPS, discusses the nature and extent of these inorganic constituents in groundwater, evaluates potential corrective measures to address SSLs in groundwater, and presents monitored natural attenuation (MNA) as the proposed groundwater remedy for preliminary review by GA EPD. At GA EPD's request, a public meeting will be held after the agency's preliminary review of this Draft Report to discuss the assessment of corrective measures and proposed remedy, after which a remedy will be selected, and the Remedy Selection Report will be submitted to GA EPD. Once a remedy is selected and implemented, the remediation will be monitored routinely and subject to potential modification based on adaptive management strategies, as appropriate.

2 Background

2.1 Remedy Selection Process

The remedy selection process involves assessment of potentially applicable groundwater remediation approaches. To date, this process has occurred as reported in previous submittals including the Assessment of Corrective Measures Report – Plant Yates Ash Ponds 3, A, B, and B' (Atlantic Coast Consulting [ACC] 2019a) and Semiannual Remedy Selection and Design Progress Reports (ACC 2019b, ACC 2020a, Arcadis 2020, Arcadis 2021a, Arcadis 2021b, and Arcadis 2022).

The remedy selected for the unit must meet the following required criteria:

§257.97 Selection of Remedy [Required Criteria]

(b) Remedies must:

(1) Be protective of human health and the environment;

(2) Attain the groundwater protection standard as specified pursuant to §257.95(h);

(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment;

(4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;

(5) Comply with standards for management of wastes as specified in §257.98(d).

Technologies that meet the required criteria are then evaluated using the following comparative criteria:

§257.97 Selection of remedy [Comparative Criteria]

(c) In selecting a remedy that meets the standards of paragraph (b) of this section, the owner or operator of the CCR unit shall consider the following evaluation factors:

(1) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:

(i) magnitude of reduction of existing risks;

(ii) magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;

(iii) the type and degree of long-term management required, including monitoring, operation, and maintenance;

(iv) short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;

(v) time until full protection is achieved;

(vi) potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;

(vii) long-term reliability of the engineering and institutional controls; and

(viii) potential need for replacement of the remedy.

(2) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:

(i) the extent to which containment practices will reduce further releases; and
(ii) the extent to which treatment technologies may be used.

(3) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:

(i) degree of difficulty associated with constructing the technology;
(ii) expected operational reliability of the technologies;
(iii) need to coordinate with and obtain necessary approvals and permits from other agencies;
(iv) availability of necessary equipment and specialists; and
(v) available capacity and location of needed treatment, storage, and disposal services.

(4) The degree to which community concerns are addressed by a potential remedy(s).

Using the above criteria, this document evaluates the potential remedies identified in the Assessment of Corrective Measures (ACM) and subsequent updates to identify an appropriate groundwater remedy for the unit. Selection of an appropriate groundwater remedy is significantly influenced by CCR constituent chemistry and characteristics of Appendix IV parameters, which are inorganic trace elements – metals and metalloids that have attenuation and remediation characteristics markedly different than organic constituents. Common chemical mechanisms of attenuation for CCR constituents include adsorption to, or coprecipitation with, oxides and hydrous oxides (oxyhydroxides) of iron and manganese; coprecipitation with, and adsorption to, iron sulfides such as pyrite (FeS2); and precipitation as carbonates, sulfides, sulfates, and/or phosphates (USEPA 2007; Electric Power Research Institute 2018). The attenuation capacity can be evaluated through site-specific field and laboratory testing and geochemical modeling. Processes such as precipitation/co-precipitation and adsorption and other methods such as groundwater extraction and treatment and engineered plant uptake (phytoremediation) are also evaluated for the remediation and adaptive management of Appendix IV constituents. The selected remedy will meet the criteria of §257.97(b) and the effectiveness of criteria specified in §257.97(c).

An evaluation of the degree to which community concerns are addressed by a potential remedy is not included in this Draft Groundwater Remedy Selection Report. A discussion of this criterion will be substantially informed by a forthcoming public meeting following GA EPD preliminary review and comment on this Draft Groundwater Remedy Selection Report. Following the public meeting, the Groundwater Remedy Selection Report will be prepared for submission to GA EPD and will include a discussion of the "degree to which community concerns are addressed by a potential remedy."

2.2 Unit Location and Description

Plant Yates is located at 708 Dyer Road on the east bank of the Chattahoochee River in Coweta County, Georgia, near the Coweta and Carroll County line, approximately 8 miles northwest of the city of Newnan and 13 miles southeast of the city of Carrollton. A general site layout is shown on Figure 1. Plant Yates was built after World War II and originally had seven coal-fired steam-generating units (Units 1 through 7). Units 1 through 5 were retired in 2015 following approval by the Georgia Public Service Commission through the company's 2013 Integrated Resource Plan. The two largest units (Units 6 and 7) were converted from coal to natural gas and remain in service. Plant Yates consists of multiple CCR units that are in the process of being closed in accordance with federal and state regulations. Selenium SSLs at the waste boundary for the CCR units AP-3, A, B, and B', and the R6 CCR Landfill are the subject of this Draft Groundwater Remedy Selection Report.

2.3 Unit Closure

CCR placement in AP-3, AP-A, AP-B, and AP-B' ceased in 2014 after Plant Yates ceased burning coal at the site. Closure activities in accordance with 40 CFR 257.100 were initiated on December 7, 2015 (AP-A) and April 20, 2018 (AP-B, AP-B', and AP-3). AP-A and AP-B are being closed by removal with consolidation of CCR from those impoundments to AP-B’ and AP-3, which make up the footprint of the Ash Management Area (AMA). A final cover system will be placed over the consolidated AMA footprint.

AP-A and AP-B closure construction activities consist of removal of all CCR and an additional 6 inches (minimum) of over-excavation and placement in the AMA.

CCR consolidated within the AMA waste footprint is moisture conditioned, spread, and compacted prior to capping with the final cover system. The final cover system will be graded to prevent erosion, provide adequate levels of slope stability, and promote positive drainage for surface water runoff. The cover system consists of a prepared subgrade overlain with a 50 mil geomembrane and ClosureTurf® engineered synthetic turf. The final cover system will eliminate infiltration to the maximum extent feasible.

CCR placement in the R6 CCR Landfill ceased in October 2015. The R6 CCR Landfill is being closed in place and has been covered in accordance with the closure plan. The final cover consists of a minimum of an 18-inch infiltration barrier layer of clayey soil placed and compacted in accordance with the design specifications and a minimum of a 6-inch surface layer of topsoil capable of supporting vegetation growth. The final cover system was graded to prevent erosion and promote drainage.

In addition, Georgia Power is implementing an engineering measure to supplement the closure design. The engineering measure selected for Plant Yates is a subsurface drain system that will serve as a hydraulic conveyance with active pumping. The subsurface drain engineering measure and associated risers and pumps are designed to lower and sustain a lowered groundwater elevation relative to the elevation of the CCR closed in place (Deason et al. 2021). The effect of the decrease in the groundwater elevation translates into a reduction in the volume of CCR present below the potentiometric surface as compared to pre-closure conditions (TRC 2020), as well as the capture and removal of groundwater that has been in contact with CCR.

Closure by removal areas, AMA, R6 CCR Landfill, and the subsurface drain are depicted on Figure 2.

Following closure completion, a minimum post-closure care period of thirty (30) years will apply. Post-closure care is detailed in the Permit Application, Part A, Section 8. Georgia Power will retain ownership of the Site following closure.

2.4 Groundwater Monitoring

The current groundwater monitoring network for the CCR unit includes the background/upgradient and downgradient monitoring wells, as summarized in Tables 1A and 1B and shown on Figure 3.

CCR groundwater monitoring-related activities have been performed at the site since 2016. The following Appendix IV SSL parameter and well pairs are the subject of this report:

Table 2. Appendix IV SSL Summary

Appendix IV Parameter[1]	Monitoring Well ID
Selenium	YGWC-38, PZ-37

Monitoring wells YGWC-33S, YGWC-38, and YGWC-41 exhibited SSLs in the past that are no longer present at the site.

YGWC-41: Concentrations of selenium have decreased to less than the GWPS and the statistical analysis no longer indicates an SSL.

YGWC-33S: Concentrations of beryllium and cobalt were above the GWPS before it was abandoned in June 2020 because it was within the waste boundary. Upon further statistical evaluation using pooled upgradient well data from across Yates rather than only the wells immediately upgradient of AMA-R6, cobalt was not found to exhibit an SSL. Monitoring wells YGWC-36A, YAMW-1 and PZ-35 installed at the waste boundary downgradient of YGWC-33S are below the GWPS beryllium and cobalt.

YGWC-38: Concentrations of beryllium have decreased to less than the GWPS and statistical analysis no longer indicates an SSL.

Additional details regarding the statistical analyses are provided in the annual and semiannual *Groundwater and Corrective Action Monitoring Reports* submitted to GA EPD and posted on Georgia Power's website.

[1] An SSL-related constituent is determined by comparing the confidence intervals developed to either the constituent's maximum contaminant level (MCL), if available; the calculated background interwell prediction limit; or for cobalt, molybdenum, lithium, and lead, the promulgated concentrations at 40 CFR §257.95(h)(2).

3 Groundwater Conceptual Site Model

A CSM is a dynamic tool that contextualizes available geological, hydrogeological, and geochemical information at a site to convey how groundwater and constituents (Appendix III and IV parameters) travel in a geologic setting. A CSM is not static and may evolve as data are collected and more is known about the setting. A CSM was developed for the site. As data were gathered during the ACM process, the CSM was refined and used to pre-screen remedial technologies, retaining technologies that were suitable for consideration in remedial alternatives for groundwater or adaptive management based on site-specific conditions.

Plant Yates is located in the Inner Piedmont Physiographic Province of western Georgia, immediately southeast of the Brevard Zone, a regional fault zone that separates the Piedmont from the Blue Ridge. Rock units at Plant Yates are primarily interlayered gneiss and schists. The rocks in the area have been subjected to extensive metamorphism, deformation, and igneous intrusions. Extensive fracture sets are present in the underlying bedrock. Surface expressions of these fractures are observed on topographic maps and aerial photographs of the Plant Yates area (ACC 2020b).

Geologic cross-sections are presented on Figures 4 through 6. A soil layer, approximately 1 foot to 10 feet thick, of sand and silt with trace organic material overlies a thick layer of saprolite. The saprolite, which extends to typical depths of 20 to 40 feet below ground surface, was formed in place by the physical and chemical weathering of the underlying metamorphic rocks. The saprolite typically consists of clay- and silt-rich soils that grade to sandier soils with depth. A zone of variable thickness (approximately 5 to 20 feet) of transitionally weathered rock typically exists between the saprolite and competent bedrock. The lithology of the transition zone is highly variable and ranges from medium to coarse unconsolidated material to highly fractured and weathered rock fragments. Localized alluvial soils consisting of generally coarser material (silty sand, clayey silt, and silty clay with well-rounded gravel and cobbles) that have been observed in saprolite may be related to historical river channel migration.

Bedrock types present at the site include granitic and migmatitic gneiss, biotite gneiss, and amphibolite, all of which have highly variable mineralogy and texture. Detailed geologic mapping of the site indicates folding and faulting both north and south of the Chattahoochee River. The fault is truncated northwest and southwest of the site by an unnamed, strike-slip fault, referred to as the Yates Fault (Golder 2017). Foliation is dominantly north-south trending and moderately dipping to the southeast. Fracture sets have also been mapped paralleling the foliation orientation. Additional fracture sets have been observed trending northwest/northeast and dipping steeply to the southeast and southwest. The development of the observed faults, foliation orientation, and lithologic variations in the bedrock are interpreted to have created an upright, slightly overturned, west-verging antiformal structure that is present in the central portion of the site (see excerpted map Golder 2017 provided in Appendix A).

Borehole geophysics conducted at the site indicate strike and dip angles of the fractures oriented toward the southeast at an average of 120 degrees, with an average dip angle of the fractures of approximately 25 degrees. Fracture data from adjacent boreholes located within the AMA-R6 CCR Landfill area indicate the potential for interconnectivity of various fracture zones across the site. Additionally, fracture orientations encountered in the borehole are similar in orientation to mapped foliation orientations (Golder 2017). Borehole geophysics conducted in BH-52 near PZ-37 in 2021 determined a similar fault orientation and dip angle (toward the southeast and dipping approximately 25 degrees) and further suggest the potential for interconnectivity of structural features beneath and adjacent to the R6 CCR Landfill (Arcadis 2021c).

Groundwater is typically encountered slightly above the saprolite/weathered rock interface. Groundwater flow in the saprolite zone is through interconnected pores and relict textures and fractures. As the rock becomes increasingly competent with depth, groundwater flow occurs mainly through joints and fractures (i.e., secondary porosity). Recharge to the water-bearing zones in fractured bedrock takes place by seepage through the overlying saprolite or by direct entrance through openings in outcrops and varies with topography. The water table occurs in the saprolite and in the transitionally weathered zone, at least several feet above the top of rock.

Figure 7 presents a groundwater elevation map. Groundwater flow direction in the upper aquifer is controlled by topography, drainage features, and human-made surface impoundments (ACC 2020b). The general site-wide groundwater flow direction is from the east to west with localized flow direction controlled by surface water bodies. Groundwater flow beneath the AP-3, A, B, B’ and the R6 CCR Landfill in the uppermost aquifer is from three directions: south to north, southeast to northwest, and east to west, as shown on Figure 7. These three flow directions are controlled somewhat by the former surface water drainage swale that meandered from the southeast corner of the site, around the southeast and south corners of the AMA, and between the AMA and the R6 CCR Landfill. The groundwater level data at the site supports topography-controlled groundwater flow with a downward hydraulic gradient from the residuum material in areas of topographic highs and an upward hydraulic gradient near discharge areas.

3.1 Nature and Extent of Groundwater Above the Groundwater Protection Standard

Based on statistical analysis of Appendix IV groundwater data, the selenium SSLs identified in the compliance wells are horizontally and vertically delineated to levels below GWPS. Based on selenium groundwater data collected to date, horizontal and vertical delineation is complete. Please refer to the February 2022 isoconcentration map for selenium presented on Figure 8. Monitoring wells with SSLs and the pertinent horizontal and vertical delineation wells are also indicated below in Table 3.

The selenium SSL at well YGWC-38 is horizontally delineated by downgradient wells YGWC-23S and YGWC-36A, PZ-35, and YAMW-1 to below the GWPS.

To delineate the vertical extent of selenium concentrations observed at PZ-37, a deep bedrock boring, BH-52, was drilled in August-September 2021. The boring was also used to characterize the structural features in the bedrock using borehole geophysical tools. The borehole was drilled to a total depth of 200 feet below ground surface (bgs). Core samples from the borehole were logged for lithologic properties. Well construction and development information are provided in Appendix C of the 2021 Annual Groundwater Monitoring and Corrective Action Report (Arcadis 2022).

After reaching total depth, Arcadis collected borehole geophysical logs using a portable Matrix system manufactured by Mount Sopris Instrument Company in Golden, Colorado. Packer testing was conducted at specified intervals based on the results of the geophysical logging and identified fracture zones.

After the completion of geophysical logging and packer testing, two monitoring wells were installed in the BH-52 borehole (well PZ-52D and PZ-53D) to delineate the nature and extent of selenium and support the understanding of groundwater conditions in the vicinity of PZ-37, PZ-37D, YGWC-38, and YAMW-5. PZ-52D was screened from 82 to 92 feet bgs and PZ-53D was screened from 150 to 160 feet bgs. The well installation procedures and specifications are provided in Appendix C of the 2021 Annual Groundwater Monitoring and Corrective Action Report (Arcadis 2022). Analytical laboratory results associated with the newly installed PZ-52D are provided in

Tables 1A and 1B. Concentrations of Appendix IV constituents were less than the GWPS, as shown on Figure 8 for selenium. PZ-52D will continue to be monitored to provide additional support for delineation of constituents and remedy selection. Since the vertical extent of selenium is delineated by well PZ-52D, the deeper well PZ-53D will be used for water level monitoring and not for routine sampling.

Table 3. Selenium Delineation Summary

Detected Constituent	GWPS (mg/L)	Monitoring Well ID	Concentration (mg/L)
Selenium	0.05	Monitoring Wells with Concentrations Greater than GWPS	
		YGWC-38	0.064
		YAMW-5	0.057
		PZ-37	0.200
		Vertical Delineation Wells	
		PZ-37D	< 0.0014
		PZ-52D	0.0025 J
		Horizontal Delineation Wells	
		YGWC-23S	0.039
		YGWC-36A	< 0.0014
		YAMW-1	0.0034 J
		PZ-35	0.0030 J

Notes:
< less than reporting limit indication
mg/L = milligrams per liter
J = estimated value

4 Assessment of Correction Measures Summary

An ACM Report was completed in June 2019 (ACC 2019a) in accordance with 40 CFR §257.96 and identified the following corrective measures as potentially applicable to remediate groundwater at the site:

Geochemical Manipulation (In-Situ Injection [ISI]);

Hydraulic Containment (Pump and Treat);

In-Situ Solidification/Stabilization;

Monitored Natural Attenuation (MNA);

Phytoremediation;

Permeable Reactive Barriers; and

Subsurface Vertical Barrier Walls.

Georgia Power also plans to proactively utilize adaptive site management to support the remedial strategy and address potential changes in site conditions as appropriate. Under an adaptive site management strategy, a remedial approach will be selected whereby: (1) a remedy will be installed or implemented to address current conditions; (2) the performance of the remedy will be monitored, evaluated, and reported semiannually; (3) the CSM will be updated as more data are collected; and (4) adjustments and augmentations will be made to the remedy, as warranted, to achieve site objectives.

Further evaluation and refinement of the groundwater corrective measures since completion of the ACM Report was presented in Semiannual and Annual Remedy Selection Progress Reports submitted in 2019, 2020, 2021, and 2022 (ACC 2019b, ACC 2020a, Arcadis 2020, Arcadis 2021a, Arcadis 2021b, and Arcadis 2022). The corrective measures identified for the CCR unit in the ACM Report were further evaluated using the criteria outlined in 40 CFR §257.96(c) and GA EPD Rule 391-3-4.10(6)(a). The screening of the corrective measures, as presented in the Annual and Semiannual Remedy Selection and Design Progress Reports, is summarized in Table 4. Permeable reactive barriers and subsurface vertical barrier walls were screened out due to limits on implementability, performance and effectiveness in the site-specific hydrogeology. In situ stabilization/solidification is impractical to implement at the scale of the site and was also screened out.

The corrective measures that were not screened out and that were retained for further evaluation under the 40 CFR §257.97 remedy selection criteria in this document include the following:

Monitored Natural Attenuation – MNA is defined as the reliance on natural attenuation processes (within the context of a carefully controlled and monitored site remedial approach) to achieve site-specific objectives, in this case GWPS, within a timeframe that is reasonable compared to that offered by other, more active methods (USEPA 2007). MNA is a remedial solution that takes advantage of natural attenuation processes to reduce constituent concentrations in groundwater.

Hydraulic Containment (Pump and Treat) – Hydraulic control/containment (pump and treat) uses groundwater extraction to establish a hydraulic gradient to capture and control the migration of groundwater that is impacted by a constituent of concern. The remedy combines a groundwater extraction system with a treatment system to remove target analytes from the subsurface and/or to control/prevent constituent migration.

Geochemical Manipulation (In-Situ Injections) – ISI is the application of reagents in the subsurface to influence the solubility, mobility, and/or toxicity of inorganic constituents. The injection of a chemical or organic substrate would be intended to alter geochemical conditions to those more favorable for stabilization of selenium.

Phytoremediation – Phytoremediation is the direct use of various living plants as a means of hydraulic control or containment, immobilization of constituents, and/or uptake/degradation of constituents in shallow groundwater.

The two alternatives discussed in further detail below are MNA and ISI, which are retained as corrective measures for evaluation against the remedy selection criteria specified in 40 CFR §257.97(b,c). Hydraulic containment remedies (pump and treat and phytoremediation) are not advanced in the evaluation because they would provide little incremental reduction of the current extent of selenium above GWPS outside the waste boundary given the predicted gradients of the subsurface drain operation. However, pump and treat and phytoremediation measures could be considered during adaptive management over the course of remedy implementation. Table 4 summarizes measures retained for further evaluation and adaptive management.

Alternative 1: MNA

Alternative 1 relies on natural attenuation processes to achieve the GWPS at the waste boundary. Natural attenuation processes, including sorption, dilution, and dispersion, are sufficient to reduce concentrations of selenium below the GWPS at the waste boundary as demonstrated in the geochemical CSM and site specific demonstration of natural attenuation (Appendices B and F). Consistent with Environmental Protection Agency guidance for the implementation of MNA for inorganics (USEPA 2015), consideration of MNA based on these mechanisms is considered in this evaluation as a polishing step for the groundwater plume in light of unit closures and related source control benefits. The conceptual remedy design for Alternative 1 is shown on Figure 9.

Alternative 2: ISI

Alternative 2 relies on stabilizing selenium by altering geochemical conditions in groundwater using in-situ injections. In situ immobilization of selenium could be achieved through the addition of various in situ reagents. For example, reagents to achieve the reduction of selenium to insoluble forms like elemental selenium or iron selenides include inorganic reagents (e.g., various forms of iron) or organic reagents (e.g., sugars, alcohols or oils) to promote chemical and/or biotic reduction and other immobilization mechanisms. For the purpose of evaluating ISI against the remedy selection criteria, a conceptual design was considered. In the conceptual design, the injections use zero-valent iron (ZVI) to immobilize selenium through reduction and adsorption. To evaluate this alternative, hypothetical ZVI injections are conceptualized in two transects to create in-situ reactive zones; as groundwater passes through the zone, selenium is immobilized. Each transect consists of approximately 15 to 20 injection points, spaced 10 feet apart with injection screened intervals located within saprolite and partially weathered rock units. The conceptual remedy design for Alternative 2 is shown on Figure 10.

Preliminary or conceptual remedy design drawings of the two alternatives are shown on Figures 9 and 10. Because the layouts are considered conceptual, the configuration of the implemented remedy may be adjusted during the detailed design process.

5 Corrective Measures Evaluation

The purpose of this section is to evaluate the two corrective measures alternatives under the required criteria described in 40 CFR §257.97(b) and rank them using the comparative criteria described in 40 CFR §257.97(c).

5.1 Required Criteria (§257.97(B))

As described in 40 CFR §257.97(b), for a groundwater corrective measure to be selected, it must meet the following criteria:

Be protective of human health and the environment;

Attain the GWPS as specified pursuant to 40 CFR §257.95(h);

Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment;

Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems; and

Comply with standards for management of wastes as specified in 40 CFR §257.98(d).

The corrective measures alternatives are evaluated against the required criteria in the following subsections. As shown below, both alternatives evaluated meet or exceed the required criteria.

5.1.1 Protective of Human Health and the Environment (§257.97(b)(1))

CCR is classified as a non-hazardous RCRA solid waste, a determination confirmed in 40 CFR §257 Preamble part III.A. Nevertheless, Georgia Power conservatively and protectively conducted a risk evaluation. The Risk Evaluation Report (Wood 2021) was prepared for Plant Yates and was submitted in the remedy selection and design progress report dated January 2021 and has been updated in Appendix D. The evaluation is one of many lines of evidence presented herein and factored into the remedy selection process. The risk evaluation for the SSL-related constituents in groundwater at Plant Yates was conducted using methods consistent with GA EPD and USEPA guidance and included multiple conservative assumptions. A conceptual exposure model was developed, initial groundwater risk screening was conducted, and a refined risk evaluation was conducted for retained constituents of potential interest for hypothetical off-site receptors. Selenium was delineated to concentrations not exceeding health-protective screening criteria on site. Based on the evaluation, selenium observed in groundwater at the site is not expected to pose a risk to human health or the environment.

Accordingly, no further risk evaluation of groundwater or surface water is warranted in connection with the remedy selection process. Because no adverse human health or environmental risk currently exists, human health and the environment will be protected through implementation of both of the remedies being evaluated.

5.1.2 Attain the Groundwater Protection Standards (§257.97(b)(2))

Both of the proposed remedies attain the GWPS at the compliance boundary (waste boundary). For each of the remedies retained, attainment of the GWPS is expected based on constituent transport evaluations.

Alternative 1- MNA was evaluated for ability to reach groundwater protection standards and other criteria using USEPA issued MNA technical guidance specific to inorganic constituents (USEPA 2007) that contained four "tiers," which were later described as "phases" (USEPA 2015). Under this guidance, each successive phase of the MNA evaluation is designed to progressively consider existing and long-term attenuation characteristics of the aquifer and incrementally reduce uncertainty at each decision-making screening step. Supporting data interpretations from the Geochemical CSM (Appendix B) and the Site-specific Demonstration of Natural Attenuation (Appendix F) were used to inform the phased evaluation as follows:

> Phase I: Demonstration that the groundwater plume is not expanding through Mann-Kendall analysis of historical analytical data.
>
> Phase II: Determination that the mechanism and rate of the attenuation process are sufficient through speciation analysis, general chemical analysis, mineralogical analysis, sorption studies and Sen's slope analysis.
>
> Phase III: Determination that the capacity of the aquifer is sufficient to attenuate the mass of contaminant within the plume through mineralogical analysis and sorption studies and the stability of the immobilized contaminant is sufficient to resist remobilization through analysis of likely future groundwater conditions.
>
> Phase IV: Design of a performance monitoring program based on an understanding of the mechanism of the attenuation process, and establishment of contingency remedies tailored to site-specific characteristics will be forthcoming upon approval of the Remedy Selection Report.

Alternative 2- ISI would also support the attainment of GWPS. The groundwater flow and constituent transport evaluations, and associated input parameters, for both of the remedies are described in detail in Appendix C and show that the GWPS can be met at the compliance boundary within the next 10 years. Additional statistical trend evaluation for Alternative 1 (MNA) corroborates this timeframe estimate (Appendix E).

5.1.3 Control the Source of Release (§257.97(b)(3))

In connection with a remedy, the source of the contamination must be controlled to reduce or eliminate, to the maximum extent feasible, further releases by identifying and locating the cause of the release. The following section describes how the source control required criteria is met in connection with the each evaluated alternative.

Closure-in-place is being completed safely and in compliance with applicable federal and state regulations and is protective of public health and the environment. Closure construction is near final at the R6 Landfill and is being implemented at the AMA by consolidation and capping of CCR material. Closure of the CCR units will contribute to a reduction in concentrations of Appendix IV constituents in downgradient groundwater and overall attenuation of groundwater concentrations, as is already being demonstrated by site groundwater concentration trends (Appendix B).

In addition, Georgia Power has incorporated an engineering measure into the closure design. The engineering measure selected for Plant Yates includes a subsurface drain for the collection and conveyance of groundwater. The purpose of the subsurface drain is to collect and remove groundwater from the area, which will result in lowering the potentiometric surface. The effect of the decrease in the groundwater elevation translates into a reduction in the volume of CCR present below the potentiometric surface as compared to pre-closure conditions. In addition, the subsurface drain will remove and manage groundwater that has been in contact with CCR.

The control provided by the closure ensures that, for the purpose of remedy selection, the control requirement is met for all corrective measures being evaluated. Neither of the alternatives will interfere with the control provided by the closure in 40 CFR §257.102.

In addition, Appendix IV constituents beyond the waste boundary that are present above GWPS will be controlled by the groundwater remedy:

MNA – The natural attenuation processes that are at work in such a remedial approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of constituents in groundwater. To support MNA as a potential corrective action, data collected from soil and groundwater analyzed in laboratory studies show specific immobilization and other attenuation mechanisms, sorption, dilution and dispersion, will occur and are anticipated to be stable, as documented in the geochemical CSM in Appendix B and the site-specific demonstration of natural attenuation in Appendix F. These in-situ processes, applicable to inorganic constituents found in CCR, effectively attenuate the movement of inorganic CCR constituents in groundwater, thereby controlling contaminant release/movement beyond the waste boundary. Consistent with Environmental Protection Agency guidance for the implementation of MNA for inorganics (USEPA 2015), consideration of MNA based on these mechanisms is considered in this evaluation as a polishing step for the groundwater plume in light of unit closures and related source control benefits.

ISI – Selenium can be immobilized under different combinations of pH and oxidation-reduction (redox) conditions. ISI would create an in-situ reactive zone at two transects in the groundwater plume, creating conditions for redox reactions and physical processes to take place. These processes would chemically immobilize constituents in groundwater through precipitation and sorption, which effectively remove the constituents from groundwater, thereby controlling contaminant release/movement beyond the waste boundary.

5.1.4 Removal of Contaminated Material from the Environment (§257.97(b)(4))

The remedial alternatives retained for further consideration would be effective at removing Appendix IV constituents from groundwater, either through processes of immobilization or chemical attenuation in groundwater, as provided below:

The remedies considered herein remove contaminated material from the environment as follows:

MNA – The natural attenuation processes that are at work in such a remedial approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. Sorption and redox reactions are the dominant mechanisms responsible for the reduction of mobility, toxicity, or bioavailability of inorganic contaminants. These processes remove contamination from the environment by reducing the presence of contaminants in groundwater.

Geochemical Approaches (In-Situ Injection) – Selenium can be immobilized under different combinations of pH and redox conditions. Injections would create an in-situ reactive zone at two transects where selenium is present above GWPS beyond the waste boundary. The injections remove contamination from the environment by reducing the presence of contaminants in groundwater through immobilization and/or precipitation.

5.1.5 Comply with Waste Management Standards (§257.97(b)(5))

In accordance with 40 CFR §257.98(d), any waste generated during the implementation of any of the remedies under consideration would be managed in a manner that complies with any applicable requirements of the Resource Conservation and Recovery Act and the Georgia Comprehensive Solid Waste Management Act.

Table 5. Summary of Required Criteria

Required Criteria	Alternative 1 - (MNA)	Alternative 2 - (ISI)
Be protective of human health and the environment	✓	✓
Attain the groundwater protection standards	✓	✓
Control the source of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents into the environment	✓	✓
Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems	✓	✓
Management of waste to comply with all applicable RCRA requirements	✓	✓

5.2 Comparative Criteria (§257.97(C))

This section compares the alternatives using the comparative criteria listed in 40 CFR §257.97(c). Each of the comparative criteria consists of several sub-criteria listed in the CCR Rule, which are considered in this remedy selection below. The goal of this analysis is to further evaluate the alternatives that meet the required criteria to support remedy selection. Consistent with 40 CFR §257.98(b), the selected and implemented remedy will be continually evaluated and, if warranted, modified consistent with adaptive management practices.

A graphic is provided for each category of comparative criteria to visually depict the favorability of each alternative, where dark green represents that the "option's performance under this criterion is *highly favorable*," medium green represents that the "option performs *favorably* under this criterion," and light green represents that the "option performs *less favorably* under this criterion."

Color Legend:

(dark green)	Option's performance under this criterion is *highly favorable*
(medium green)	Option performs *favorably* under this criterion
(light green)	Option performs *less favorably* under this criterion

5.2.1 Long- and Short-Term Effectiveness and Protectiveness

This comparative criterion takes into consideration the following sub-criteria relative to the long-term and short-term effectiveness of each remedy. Long-term effectiveness and permanence mean that the remedy will protect human health and the environment after the GWPS have been met.

The short-term effectiveness means that the remedy will be protective of human health and the environment during construction and implementation of the remedy. The degree of protection and the time period to achieve GWPS are also considered.

5.2.1.1 Magnitude of reduction of existing risks

As indicated by the nature and extent evaluation, the most recent groundwater sampling results, and the Risk Evaluation Report summarized in Section 5.1.1, Appendix IV constituents in groundwater at the site are not expected to pose a risk to human health or the environment. Therefore, this criterion is considered highly favorable for both remedial alternatives. In addition, each groundwater remedy retained for this comparative analysis will be effective at reducing concentrations to levels below the GWPS, as described in Section 5.1.2 above.

5.2.1.2 Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy

Unit closure provides effective source control, as described in Section 2.3 above. As noted in the groundwater modeling report (Appendix C), each of the groundwater remedies retained for comparison will be effective at reducing the concentration of Appendix IV constituents in groundwater beyond the waste boundary to levels below the GWPS. Consequently, all remedies being evaluated perform similarly for purposes of this criterion and, therefore, this criterion is considered highly favorable for both remedies being evaluated.

5.2.1.3 The type and degree of long-term management required, including monitoring, operations, and maintenance

In accordance with 40 CFR §257.97(c)(1)(iii), this sub-criterion considers the long-term management of each groundwater remedy.

Both Alternative 1 - MNA and Alternative 2 - ISI will require monitoring during the period to reach GWPS and after for 3 years. The duration of groundwater remedy monitoring is anticipated to be somewhat less for Alternative 2 (see section 5.2.1.5). However, Alternative 2 may require greater activity for re-injection during the period to reach GWPS, and so is considered less favorable overall than Alternative 1. In addition to groundwater remedy monitoring, per CCR rule requirements, post closure care monitoring, including groundwater sampling and reporting, will continue for no less than 30 years because this is a closure in place site.

5.2.1.4 Short-term risks that might be posed to the community or the environment during implementation of such a remedy

In accordance with 40 CFR §257.97(c)(1)(iv), this sub-criterion relates to the potential for threats to human health (including without limitation worker safety and the community) and the environment associated with remedy implementation.

Community impacts include general impacts to the community, such as increased truck traffic, noise and vehicle emissions during construction. Although Alternative 2 (ISI) will require active injection implementation beyond what is anticipated for Alternative 1 (MNA), the impact to the community will be minimal for both alternatives. For both alternatives, remedial activities will take place on Georgia Power property. Based on these considerations, both alternatives are rated highly favorable for this criterion.

5.2.1.5 Time until full protection is achieved

In accordance with 40 CFR §257.97(c)(1)(v), the time until the GWPS is achieved for a period of three years (in accordance with 40 CFR §257.98(c)(2)) for each of the remedies is presented in the transport modeling evaluations.

As previously stated, the risk evaluation for the SSL-related constituents in groundwater at Plant Yates was conducted using methods consistent with GA EPD and USEPA guidance, included multiple conservative assumptions, and concluded that the impacts are not expected to pose a risk to human health or the environment; therefore, overall protection is already achieved. The timeframes to achieve the GWPS at the waste boundary were evaluated using a predictive groundwater flow and transport model (Appendix C) and trend analysis (Appendix E), and all timeframes are considered reasonable. Predictions to meet GWPS at PZ-37 were used to represent the timeframe to reach GWPS at the compliance boundary. Solute transport modeling predicts GWPS are reached within approximately 10 years, while the trend analysis indicated GWPS would be reached between within one to six years. Solute transport modeling indicated GWPS at PZ-37 would be reached for Alternative 2 - ISI within approximately a year of injections. Alternative 1 is predicted to take more time to achieve the GWPS than Alternative 2 - ISI. Based on these estimated timeframes, Alternative 1 -MNA was rated highly favorable, while Alternative 2 - ISI is rated favorable. However, both achieve GWPS within a reasonable timeframe.

5.2.1.6 Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment

In accordance with 40 CFR §257.97(c)(1)(vi), this sub-criterion considers elements such as CCR outside of the unit boundary or the handling of impacted groundwater encountered during construction and operation of the remedy.

Alternative 1 - MNA and Alternative 2 - ISI are considered highly favorable and comparable to each other since neither approach requires management of remaining wastes and potential exposure through contact with CCR or groundwater is minimal for both alternatives.

5.2.1.7 Long-term reliability of the engineering and institutional controls

The following describes the overall long-term reliability for each of the proposed groundwater remedial alternatives for purposes of comparison. Of note, the reliability of all alternatives is bolstered by the long-term reliability of the closure method and its expected positive effect on groundwater conditions.

Alternative 1 - MNA is expected to have high long-term reliability and is considered highly favorable with respect to this criterion. Alternative 2 - ISI is only considered favorable since this remedy would also require extensive field pilot studies and bench-scale testing, rely on injection systems to implement and maintain, potentially be vulnerable to subsurface reliability issues such as injection point fouling and uneven reagent distribution, and could require multiple injections if the duration of reliable geochemical conditions stimulated is not adequate. Deed restrictions to prevent exposure to impacted groundwater will be equally reliable for both alternatives.

5.2.1.8 Potential need for replacement of the remedy

Any need to replace a remedy would be based on a systematic site review during the remedy implementation process if warranted to improve remedy protectiveness, increase effectiveness, or facilitate progress toward meeting site goals. In accordance with 40 CFR §257.98(b), adaptive site management practices will be used to modify or replace the remedy if the requirements of 40 CFR §257.97(b) are not being achieved.

Alternative 1 - MNA is considered the remedy with the lowest likelihood of requiring replacement because natural processes will reduce the concentrations of Appendix IV constituents in groundwater over time and monitoring infrastructure typically does not require frequent replacement. Alternative 2 - ISI, which relies on in-situ treatment to address selenium, is considered less favorable because the longevity of the reagent for treatment of selenium is uncertain and re-injections could be required.

During the implementation process, all remedies will be evaluated for effectiveness and modified if remedial objectives are not being met, in accordance with adaptive site management practices and 40 CFR §257.98(b).

5.2.1.9 Long- and short-term effectiveness summary

This subsection provides a summary of the eight 40 CFR §257.97(c)(1) sub-criteria that are discussed in this section relative to long- and short-term effectiveness.

Overall, Alternative 1 - MNA is highly favorable while Alternative 2 - ISI is favorable with respect to long- and short- term effectiveness and protectiveness. Both alternatives perform highly favorably with respect to reduction of residual risks and short-term risks to the community and human and environmental receptors during remedy implementation. While Alternative 2 - ISI is projected to reach GWPS at the waste boundary more quickly than Alternative 1 - MNA, both achieve GWPS within a reasonable timeframe. Alternative 2 - ISI requires further testing to evaluate short and long-term effectiveness and reliability and could result in a greater degree of long-term management if re-injections are required.

Table 6. Category 1 – Long- and Short-Term Effectiveness, Protectiveness, and Certainty of Success Summary

	Alternative 1 - (MNA)	Alternative 2 - (ISI)
Sub-Criterion i. Magnitude of reduction of existing risks		
Sub-Criterion ii Magnitude of residual risk in terms of likelihood of further release		
Sub-criterion iii Type and degree of long-term management required		
Sub-criterion iv Short term risk to community or environment during implementation		
Sub-criterion v Time until full protection is achieved		
Sub-criterion vi Potential for exposure of humans and environmental receptors to remaining wastes		
Sub-criterion vii Long-term reliability of engineering and institutional controls		
Sub-criterion viii Potential need for replacement of the remedy		
Category 1 Summary		

Color Legend:

Option's performance under this criterion is *highly favorable*

Option performs *favorably* under this criterion

Option performs *less favorably* under this criterion

5.2.2 Source Control Effectiveness

As described in Section 5.1.3 above, the source control required criteria is satisfied in connection with both of the alternatives being evaluated. Specifically, in connection with closure, CCR material will be controlled through consolidation, where applicable, capping, and an engineering measure. The R6 CCR Landfill was closed in place and covered with an infiltration barrier in accordance with the closure plan. Within the AMA, CCR is consolidated within the AMA waste footprint, moisture conditioned, spread, and compacted prior to capping with the final cover system. The final cover system will eliminate infiltration to the maximum extent feasible through the CCR. Finally, the engineering measure selected for Plant Yates is a subsurface drain system that will serve as a hydraulic conveyance for the collection and removal of groundwater. A Georgia-registered professional engineer certified that the closure design meets the requirements of the CCR Rule.

This comparative criterion takes into consideration the ability of the remedy to control a future release and the extensiveness of treatment technologies that will be required.

5.2.2.1 The extent to which containment practices will reduce further releases

Because the source material will be controlled following CCR unit closure, the potential for further release will be substantially reduced. Appendix IV constituents that are present in groundwater at or currently beyond the waste boundary will be controlled by the groundwater remedy. Therefore, all groundwater remedy alternatives are considered highly favorable for this sub-criterion.

Alternative 1 - MNA will further reduce and remove selenium from the groundwater by natural attenuation processes. Geochemical data also indicates selenium reduction may be a potential mechanism in some portions of the site (Appendix B). Alternative 1 - MNA is anticipated to reduce concentrations of selenium to the GWPS at the waste boundary and prevent further releases downgradient of the waste boundary and is highly favorable. Alternative 2 - ISI is also highly favorable and will also further reduce selenium concentrations and remove selenium from groundwater by immobilizing selenium through reduction and sorption using a reactive zone generated via injections, reducing concentrations of selenium to the GWPS at the waste boundary and preventing further releases downgradient of the waste boundary.

5.2.2.2 The extent to which treatment technologies may be used

This section evaluates 40 CFR §257.97(c)(2)(ii) regarding the extent to which treatment technologies may be used. Alternatives that include more limited treatment approaches may be considered less favorable. Alternatives that rely on more extensive treatment approaches may be considered more favorable.

Alternative 2 - ISI relies on in-situ treatment with active injections to reduce concentrations of selenium to GWPS at the waste boundary and prevent further releases downgradient of the waste boundary. Alternative 1 - MNA, relies on natural attenuation as the treatment mechanism and, while predicted to be effective at reducing selenium concentrations at the waste boundary, would be considered less favorable with respect to this criterion. Because Alternative 2 adds a treatment technology, it is considered more favorable than Alternative 1.

5.2.2.3 Source control effectiveness summary

This subsection provides a summary of the two 40 CFR §257.97(c)(2) sub-criteria discussed in this section relative to effectiveness. Given that source control measures will be used and are the main driver to control additional releases, overall both alternatives are highly favorable for the category of source control. Adaptive site management strategies will be implemented to achieve GWPS.

Table 7. Category 2 – Source Control Effectiveness Summary

	Alternative 1 - (MNA)	**Alternative 2 - (ISI)**
Sub-criterion i Extent to which containment practices will reduce further releases		
Sub-criterion ii Extent to which treatment technologies may be used		
Category 2 Summary		

Color Legend:

	Option's performance under this criterion is *highly favorable*
	Option performs *favorably* under this criterion
	Option performs *less favorably* under this criterion

5.2.3 Ease of Implementation

This comparative criterion takes into consideration technical and logistical challenges required to implement a remedy, including practical considerations such as equipment availability and disposal facility capacity.

5.2.3.1 Degree of difficulty associated with constructing the technology

This sub-criterion considers the relative technical difficulty of implementing each of the remedies.

Implementation of a long-term monitoring program to confirm attenuation is straightforward; therefore, Alternative 1 - MNA is considered highly favorable. Alternative 2 - ISI is considered favorable; however, in-situ treatment will require additional treatability testing and field pilot studies, making it less favorable than Alternative 1.

5.2.3.2 Expected operational reliability of the technologies

This subsection compares the operational reliability of each of the proposed remedies in accordance with 40 CFR §257.97(c)(3)(ii). Typically, simple remedies that do not require the installation of significant infrastructure are generally more reliable and do not require significant operation and maintenance; more complex remedies that rely on groundwater flow or ISI or mechanical systems would be considered less favorable.

Alternative 1 - MNA and Alternative 2 - ISI are considered highly favorable with respect to operational reliability. Site-specific data and solute transport modeling indicate that MNA will be reliable with monitoring. In-situ injections may require re-injection, but those injections would be periodic and would not require constant maintenance of operating equipment that would pose a challenge for reliability.

5.2.3.3 Need to coordinate with and obtain necessary approvals and permits from other agencies

Section 40 CFR §257.97(c)(3)(iii) requires consideration be given and compared between remedies regarding the various agencies and type of permits that would be required for implementation of the groundwater remedy. A remedial alternative that could require several permits (for example, a pump and treat system) would be considered less favorable when compared to a remedial alternative that would require fewer permits (for example, MNA).

Implementation of the MNA remedy for groundwater is straightforward; therefore, Alternative 1 - MNA is highly favorable. Alternative 2 - ISI will require additional treatability testing, permitting, and approvals for field-scale pilot testing and full-scale injection, and is considered less favorable with respect to this criterion.

5.2.3.4 Availability of necessary equipment and specialists

Generally, remedies that could be implemented by local contractors and without specialty contractors or experts may be considered more favorable. Consideration should be given to specialty contractor/consultant proximity to the CCR unit, contractor or equipment availability, and the effectiveness of the proposed remedy on similar sites.

Both Alternative 1 - MNA and Alternative 2 - ISI require specialists in geochemistry, while in-situ injections also require specialists in the design and implementation of the injections themselves. Alternative 1 - MNA does not require specialty equipment beyond typical equipment for monitoring well installation and groundwater sampling. Alternative 2 - ISI will require equipment for drilling and injection well installation or direct injections, although the qualified contractors and equipment required should not present a challenge. Implementation of both alternatives would potentially be subject to challenges experienced with the global supply chain issues in recent years, although the impact for MNA would be minimal given that the monitoring well network is already largely in place. Overall, the alternatives are both considered highly favorable with respect to this criterion.

5.2.3.5 Available capacity and location of needed treatment, storage, and disposal services

This sub-criterion (40 CFR §257.97(c)(3)(v)) considers disposal options for materials generated by the groundwater remedy and land area that are available for implementation of the remedy.

Alternative 1 - MNA is considered highly favorable since no additional treatment, storage, or disposal services are anticipated. Alternative 2 - ISI is also considered highly favorable since treatment will be in-situ and generate minimal waste.

5.2.3.6 Ease of implementation summary

This subsection provides a summary of the five 40 CFR §257.97(c)(3) sub-criteria discussed in this section relative to the ease or difficulty of implementing the remedy.

Alternative 1 - MNA is highly favorable in each sub-criterion for ease of implementation because it is a straightforward implementation without additional equipment, permits, or other difficulties. Alternative 2 - ISI is less favorable for ease of implementation because it requires additional equipment installation, pilot testing, and permitting and may introduce unforeseen difficulties with implementation.

Table 8. Category 3 – Ease of Implementation Summary

	Alternative 1 - (MNA)	Alternative 2 - (ISI)
Category 3 – Sub-criterion i Degree of difficulty associated with constructing the technology		
Category 3 – Sub-criterion ii Expected operational reliability of the technologies		
Category 3 – Sub-criterion iii Need to coordinate with and obtain necessary approvals and permits from other agencies		
Category 3 – Sub-criterion iv Availability of necessary equipment and specialists		
Category 3 – Sub-criterion v Available capacity and location of needed treatment, storage, and disposal services		
Category 3 Summary		

Color Legend:

	Option's performance under this criterion is *highly favorable*
	Option performs *favorably* under this criterion
	Option performs *less favorably* under this criterion

5.2.4 Evaluation of Comparison Criteria

The various sub-criteria were evaluated, and relative comparisons were made between the remedial alternatives to determine which remedy or remedies would be expected to be the most and least favorable regarding the certainty of success. The results of this comparison are summarized in the Table below.

Table 9. Summary of Comparison Criteria

	Alternative 1 - (MNA)	Alternative 2 - (ISI)
Category 1 Long- and Short-Term Effectiveness, Protectiveness, and Certainty of Success		
Category 2 Effectiveness in controlling the source to reduce further releases		
Category 3 Ease of implementation		

Color Legend:

Option's performance under this criterion is *highly favorable*

Option performs *favorably* under this criterion

Option performs *less favorably* under this criterion

Both Alternative 1 - MNA and Alternative 2 - ISI are anticipated to be effective in controlling the source to prevent further releases. Alternative 2 - ISI requires further testing to evaluate short and long-term effectiveness and reliability, is more difficult to implement and could require re-injections. Alternative 1 - MNA is considered more favorable overall, given the favorable assessment of effectiveness and ease of implementation in comparison to the in-situ alternative.

5.3 Public Meeting and Community Engagement

As noted in Section 2.1 above, this criterion will be addressed in the Remedy Selection Report to be submitted to GA EPD after a public meeting.

6 Proposed Remedy Selection

This section provides a summary of the proposed groundwater remedy and a schedule for remedy implementation in accordance with 40 CFR §257.97(d). Georgia Power also plans to proactively utilize adaptive site management to support the remedial strategy and address potential changes in site conditions as appropriate. Under an adaptive site management strategy, a remedial approach will be selected whereby: (1) a corrective measure will be installed or implemented to address current conditions; (2) the performance of the corrective measure will be monitored, evaluated, and reported semiannually; (3) the CSM will be updated as more data are collected; and (4) adjustments and augmentations will be made to the corrective measure(s), as needed, to ensure that performance criteria and the GWPS are met.

6.1 Summary of Proposed Remedy

Based on the evaluation of corrective measures, using the required and comparative criteria presented in Section 5, Alternative 1 (MNA) is the proposed remedy for selenium in groundwater above the GWPS beyond the waste boundary (Figure 9). MNA is proposed based on the site-specific demonstration of natural attenuation mechanisms, capacity, stability, and favorable protectiveness, effectiveness, and ease of implementation in comparison to the in-situ alternative. The site-specific demonstration of natural attenuation is described Appendix F.

Remedial technologies and alternatives considered, but not proposed, herein are retained as options for adaptive management and include ISI, hydraulic containment, and phytoremediation.

6.2 Schedule

In accordance with 40 CFR §257.97(d), the following factors were considered when developing the schedule:

Extent and nature of contamination: The horizontal and vertical extent of Appendix IV constituents present in groundwater are delineated. The selected remedy will address groundwater impacts and adaptive site management practices will be utilized to evaluate whether to modify the remedial approach.

Reasonable probabilities of remedial technologies in achieving compliance with the GWPS and other remedial objectives: The selected remedy is expected to achieve compliance with the GWPS within 10 years. As considered in Section 5 of this report, the selected remedy is expected to address Appendix IV constituents in groundwater. If adequate progress is not made toward achieving the GWPS, Georgia Power will modify the remedial approach under the adaptive site management strategy, in accordance with 40 CFR §257.98(b). Site- and remedy-specific performance metrics will be developed and documented in the Corrective Action Groundwater Monitoring Plan.

Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy: As described in Section 5.1.1 of this report, the risk evaluation for selenium in groundwater at Plant Yates was conducted using methods consistent with GA EPD and USEPA guidance, included multiple conservative assumptions, and concluded that groundwater conditions are not expected to pose a risk to human health or the environment. Because of the lack of risk to human health and the environment, this factor will not impact the project schedule. Additional risks that may be present during remedy implementation are considered in Section 5 of this report, as required under 40 CFR §257.97(c)(1).

Resource value of the aquifer: As summarized in Section 5.1.1 of this report and detailed in the risk evaluation, no downgradient drinking water receptors or surface water ecological receptors were identified. Given that receptors are absent downgradient from the CCR unit, an alternative drinking water supply or interim remedial measure, as outlined in 40 CFR §257.98(a)(3), is not necessary. Further, Georgia Power will retain ownership of the site, and future development for non-industrial purposes is not currently anticipated. Because no downgradient drinking water receptors or surface water ecological receptors have been identified, this factor will not impact the project schedule.

The schedule for implementing and completing the groundwater remedial activities is described below. The general approach and implementation schedule will be modified based on new groundwater quality data obtained during the remedial implementation process, following adaptive site management practices and in accordance with 40 CFR §257.98(b).

6.2.1 Planning and Design

Planning and design of Alternative 1 includes the development of the Corrective Action Groundwater Monitoring Plan to continue to evaluate the performance of the selected remedy to reach and maintain the GWPS at the waste boundary through temporal and spatial groundwater quality monitoring. In accordance with 40 CFR §257.98(a) the Corrective Action Groundwater Monitoring Plan and program will be established within 90 days of selection of the groundwater remedy.

6.2.2 Construction and Implementation

The infrastructure of the groundwater MNA remedy is largely in place with the existing monitoring network. In accordance with 40 CFR §257.98(a), the Corrective Action Groundwater Monitoring Plan and program will be established within 90 days of selection of the groundwater remedy; however, if new monitoring well locations are deemed necessary in the approval process of the monitoring plan, additional time for installation may be required.

6.2.3 Operation

It is anticipated that the selected alternative will achieve concentrations of selenium less than the GWPS at the waste boundary within 10 years of implementation. The groundwater remedy will be considered complete when applicable regulatory requirements are satisfied. In accordance with adaptive site management practices and 40 CFR §257.98(b), the groundwater remedy will be modified if it is determined that the site goals are not being met or will not be met.

6.3 Reporting

In accordance with 40 CFR §257.105(h), Georgia Power will place the Remedy Selection Report into the site operating record. Thereafter, Georgia Power will develop a corrective action groundwater monitoring program and implement and report on the selected remedy implementation and monitoring in accordance with applicable regulatory requirements.

7 References

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Tables

Table 1A
Monitoring Well Network Summary
Draft Remedy Selection Report
Plant Yates - AP-3, A, B, B' and R6 CCR Landfill
Georgia Power Company

Well ID	Installation Date	Top of Casing Elevation (ft)	Depth to Bottom (ft bTOC)	Bottom Elevation (ft)	Depth to Top of Screen (ft bTOC)	Top of Screen Elevation (ft)	Hydraulic Location
Upgradient Wells							
YGWA-4I	5/21/2014	784.21	48.81	735.40	38.51	745.70	Upgradient
YGWA-5I	5/21/2014	784.54	58.94	725.60	48.64	735.90	Upgradient
YGWA-5D	5/21/2014	784.53	129.13	655.40	78.83	706.00	Upgradient
YGWA-17S	9/10/2015	783.05	39.85	743.20	29.55	753.20	Upgradient
YGWA-18S	9/8/2015	790.57	39.97	750.60	29.97	760.90	Upgradient
YGWA-18I	9/8/2015	790.57	79.97	710.60	69.67	720.90	Upgradient
YGWA-20S	9/29/2015	767.12	29.52	737.60	19.22	747.90	Upgradient
YGWA-21I	9/28/2015	783.70	79.90	703.80	69.60	714.10	Upgradient
YGWA-39	7/7/2016	818.19	68.59	749.60	58.09	760.10	Upgradient
YGWA-40	7/7/2016	815.73	48.23	767.50	37.73	778.00	Upgradient
YGWA-1I	5/20/2014	836.60	53.60	783.00	43.30	793.30	Upgradient
YGWA-1D	5/20/2014	837.25	128.85	708.40	78.05	759.20	Upgradient
YGWA-2I	5/20/2014	866.25	63.75	802.50	53.45	812.80	Upgradient
YGWA-3I	5/20/2014	796.55	59.05	737.50	48.85	747.70	Upgradient
YGWA-3D	5/20/2014	796.78	134.18	662.60	83.88	712.90	Upgradient
YGWA-14S	5/20/2014	748.76	34.96	713.80	24.66	724.10	Upgradient
YGWA-30I	9/23/2015	762.58	59.48	703.10	49.18	713.40	Upgradient
YGWA-47	7/11/2016	758.22	59.19	696.41	48.62	709.60	Upgradient
GWA-2	4/12/2007	805.62	52.02	753.60	41.82	763.80	Upgradient
AP-3, A, B and B'							
YGWC-23S	9/21/2015	764.95	38.91	726.00	28.61	736.30	Downgradient
YGWC-24SA	6/4/2020	765.00	57.00	708.00	47.00	718.00	Downgradient
YGWC-36A	9/22/2020	740.88	51.20	689.68	41.18	699.70	Downgradient
YGWC-49	7/13/2016	782.73	78.53	704.20	67.63	715.10	Downgradient
R6 CCR Landfill							
YGWC-38	7/23/2016	799.69	49.59	749.10	39.59	760.10	Downgradient
YGWC-41	7/8/2016	803.92	66.82	736.60	56.82	747.10	Downgradient
YGWC-42	7/8/2016	797.86	59.76	738.10	49.36	748.50	Downgradient
YGWC-43	7/9/2016	744.96	79.66	665.30	69.16	675.80	Downgradient

Notes:
Elevation is presented in U.S. Survey Feet (North American Vertical Datum of 1988) based on June 2020 survey.

Acronyms and Abbreviations:
bTOC = below top of casing
ft = feet

Table 1B
Non- Network Well Summary
Draft Remedy Selection Report
Plant Yates - AP-3, A, B, B' and R6 CCR Landfill
Georgia Power Company

Well ID	Installation Date	Top of Casing Elevation (ft)	Depth to Bottom (ft bTOC)	Bottom Elevation (ft)	Depth to Top of Screen (ft bTOC)	Top of Screen Elevation (ft)	Purpose
AP-3, A, B and B'							
YGWA-6S	5/19/2014	782.47	39.87	742.60	29.57	752.90	Piezometer
YGWA-6I	5/19/2014	782.73	69.03	713.70	58.73	724.00	Piezometer
YAMW-1	9/19/2018	743.83	69.93	673.90	59.93	683.90	Downgradient
PZ-04S	5/21/2014	784.25	32.75	751.50	22.45	761.80	Piezometer
PZ-05S	5/21/2014	784.64	41.94	742.70	31.64	753.00	Piezometer
PZ-06D	5/19/2014	782.02	134.02	648.00	83.72	698.30	Piezometer
PZ-24IA	6/3/2020	764.33	89.53	674.80	79.53	684.80	Piezometer
PZ-35	7/20/2016	743.81	50.01	693.80	38.91	704.90	Downgradient
PZ-48	7/11/2016	779.83	58.73	721.10	48.43	731.40	Piezometer
R6 CCR Landfill							
PZ-37	7/6/2016	760.78	49.78	711.00	39.28	721.50	Piezometer
PZ-37D	4/16/2021	761.12	202.30	558.80	192.30	568.80	Piezometer
PZ-51	11/8/2019	744.30	36.32	707.98	26.32	717.98	Piezometer
PZ-52D	9/28/2021	762.79	94.89	677.50	84.89	677.90	Piezometer
PZ-53D	9/28/2021	762.80	162.90	599.50	152.90	609.90	Piezometer
YAMW-2	11/12/2019	781.04	46.48	734.56	36.48	744.56	Downgradient
YAMW-3	11/6/2019	796.05	91.44	704.61	81.44	714.61	Downgradient
YAMW-4	11/7/2019	805.59	96.55	709.04	86.55	719.04	Downgradient
YAMW-5	11/13/2019	788.90	90.34	698.56	80.34	708.56	Downgradient

Notes:
Elevation is presented in U.S. Survey Feet (North American Vertical Datum of 1988).

Acronyms and Abbreviations:
bTOC = below top of casing
ft = feet

Table 4
Remedy Evaluation Summary
Draft Remedy Selection Report
Plant Yates AP-3, A, B, B', and R6 CCR Landfill
Georgia Power Company

Corrective Measure *Retained/ Screened Out*	**Geochemical Manipulation (In-Situ Injection)** *Retained*	**Hydraulic Containment** *Retained as an Option for Adaptive Management*	**In-Situ Stabilization/Solidification (ISS)** *Screened Out*	**Monitored Natural Attenuation** *Retained*	**Subsurface Vertical Barrier Walls** *Screened Out*	**Permeable Reactive Barrier** *Screened Out*	**Phytoremediation** *Retained as an Option for Adaptive Management*
Description	Injection of a chemical or organic substrate to alter geochemical conditions to those more favorable for stabilization of selenium.	Combines a groundwater extraction system with a surface treatment system to remove target analytes from the subsurface and/or to control/prevent constituent migration.	In-situ solidification is the process by which constituent mobility in a solid matrix is decreased through physical and/or chemical means. Grout or other chemical additives are mixed with aquifer materials to reduce permeability. ISS could be applied to the aquifer matrix in groundwater flow zones but is less applicable than other technologies evaluated.	A remedial solution that takes advantage of natural attenuation processes to attenuate constituents in soil and groundwater. This option can meet the GWPS given sufficient time and favorable conditions.	Used to physically control the migration of impacted groundwater flow through isolation or redirection, typically around or upgradient of a source area.	A permeable reactive barrier is a zone of reactive material that extends below the water table to intercept and treat groundwater.	Phytoremediation is the direct use of various living plants as a means of hydraulic control or containment, immobilization of constituents, and/or uptake/degradation of constituents in shallow groundwater or, if engineered, using the TreeWell® system for intermediate depth groundwater.
40 CFR 257.96(c)(1)							
Ease of Implementation	This process is not substantially limited by implementation. The hydrogeology of the site is amenable to reagent injection and distribution. Bench testing and pilot testing can be used to optimize implementation.	Relative ease in implementation compared to other technologies.	ISS technology would be difficult to impractical to implement at the scale of the AMA and R6 landfill. The implementation would also be complicated on the R6 landfill where the cap is in place.	This process is not limited by implementation. Robust performance monitoring program required.	Installing into competent bedrock may be challenging due to depth, the presence of fractures, and the groundwater flow directions at the site.	Installing into competent bedrock may be challenging due to depth and presence of fractures. Implementation is also challenging due to the groundwater flow directions at the site.	The depth of the treatment zone is limited to the depth of the root zone when relying on plants alone. When using the TreeWell® system, deeper target depths (i.e., 30 feet or more) are achievable. Site groundwater elevations are typically 10 feet to 30 feet below ground surface.
Performance	The geochemical manipulation processes identified have the potential to alter conditions and immobilize selenium rapidly, but have not been demonstrated to work in situ under site conditions. Would require ongoing monitoring to ensure that conditions remain favorable.	Hydraulic containment is an effective corrective measure for remediating dissolved constituents, provided regular maintenance is performed throughout the operational life. Not typically immediately effective for trace level metals. Rebounding can occur as water levels return to normal once the pumping system is turned off post-remediation. Generally, requires disposal of treated water and sludges.	Performance would need to be assessed through bench or pilot testing. Likely would need to be used in conjunction with an additional technology for groundwater. Technology anticipated to be less effective for groundwater than other options evaluated.	This process provides ongoing effectiveness and is well documented as an effective measure for remediating groundwater.	Performance may be limited due to site geology.	The effectiveness of this technology may be limited by underflow and reactive lifespan and is only effective for specific constituents. Marginally effective over long periods of time without replacement of PRB material.	May be directly effective by accumulation or uptake of some metals or hydraulic control; however, phytoaccumulation is directly related to the plant species. Constituents may need to be addressed by a method that does not involve direct uptake of impacted groundwater (i.e., traditional phytoremediation). An alternative method, such as a TreeWell® system, may need to be considered.

Table 4
Remedy Evaluation Summary
Draft Remedy Selection Report
Plant Yates AP-3, A, B, B', and R6 CCR Landfill
Georgia Power Company

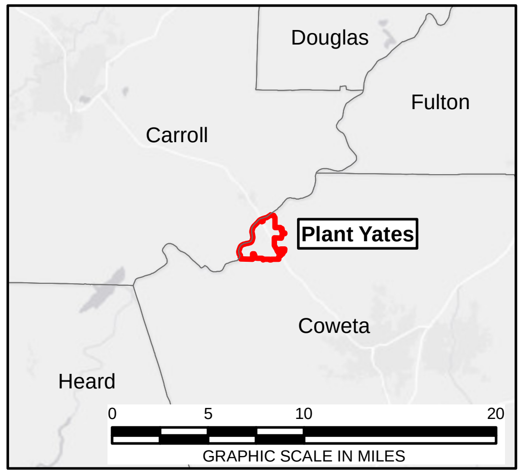
Corrective Measure *Retained/ Screened Out*	**Geochemical Manipulation (In-Situ Injection)** *Retained*	**Hydraulic Containment** *Retained as an Option for Adaptive Management*	**In-Situ Stabilization/Solidification (ISS)** *Screened Out*	**Monitored Natural Attenuation** *Retained*	**Subsurface Vertical Barrier Walls** *Screened Out*	**Permeable Reactive Barrier** *Screened Out*	**Phytoremediation** *Retained as an Option for Adaptive Management*
Potential Impacts	Low potential for impacts: health and safety concerns during injections associated with equipment, injection pressure management and reagent handling, minimal risk of cross media contamination, exposure potential limited to groundwater sampling.	Low potential for impacts: health and safety concerns during construction and O&M, injection pressure management and reagent handling, minimal risk of cross media contamination, exposure potential limited to groundwater sampling.	Low potential for impacts: No health and safety concerns during construction, minimal risk of cross media contamination, exposure potential limited to groundwater sampling.	Low potential for impacts: No health and safety concerns during construction, minimal risk of cross media contamination, exposure potential limited to groundwater sampling.	Low potential for impacts: health and safety during construction, minimal risk of cross media contamination, exposure post-construction limited to groundwater sampling.	Low potential for impacts: health and safety during construction, minimal risk of cross media contamination, exposure post-construction limited to groundwater sampling.	Low potential for impacts: health and safety during construction, minimal risk of cross media contamination, exposure post-construction limited to groundwater sampling.
Reliability	This process will likely have overall reliability in achieving GWPS goals if and when adequate volume and subsurface distribution are achieved. Ongoing monitoring is necessary to ensure that favorable conditions are maintained once achieved.	This technology provides moderate to high reliability based on extraction well up-time and maintenance for the treatment system.	Reliable immobilization over time with proper implementation.	This process will likely have overall reliability in achieving GWPS goals where impacted area remains internal to the site and is adequately monitored.	The reliability of this technology is limited at depth and may require long-term hydraulic control to manage groundwater heads.	This technology may not provide reliability in the site-specific lithology due to difficulty in interception groundwater flow though fractured bedrock.	The presence of impacted groundwater below typical root zones would need to be addressed for phytoremediation to be a reliable technology for hydraulic control. Reliable plant species for selenium uptake are established.
40 CFR 257.96(c)(2)							
Begin/Complete	Can begin immediately upon completion of pilot testing and/or bench-scale testing, which may take up to 24 months. Long-term monitoring and reporting likely required.	Time needed to model and design may take up to 24 months; variable time for construction depending on scale, generally can be accomplished in 6 months.	Time needed to model and design may take up to 24 months; variable time for construction depending on scale, generally can be accomplished relatively quickly between 6 and 12 months.	Can begin immediately. Long-term monitoring and reporting likely required.	Time needed to model and design may take up to 24 months. Variable time for construction depending on scale. Generally can be accomplished relatively quickly between 6 and 12 months, but is highlight dependent upon site conditions.	Time needed to model and design may take up to 24 months; variable time for construction depending on scale, generally can be accomplished in 6 to 12 months.	Time needed to model and design may take up to 6 months. Pilot testing may be required, which could take up to 3 years. Depending on the number of required units, the installation effort is expected to last several weeks. Full hydraulic capture/control is expected approximately 3 years after planting.
40 CFR 257.96(c)(3)							
Institutional Requirements	Deed restrictions may be necessary until in-situ treatment has achieved GWPS. A new UIC permit (for in-situ injections) would be required to implement this corrective measure. No other institutional requirements are expected at this time.	Depending on the effluent management strategy, modifications to the existing NPDES permit may be required, or obtaining a new UIC permit may be needed if groundwater reinjection is chosen. In addition, deed restrictions may be required if groundwater conditions are above regulatory standards for unrestricted use.	Deed restrictions may be necessary for groundwater areas downgradient of the stabilized and/or solidified areas. No other institutional requirements are expected at this time.	MNA may require the implementation of institutional controls, such as deed restrictions, to preclude potential exposure to groundwater within the footprint of impacted groundwater until GWPS are achieved.	Deed restrictions may be necessary for groundwater areas downgradient of the barrier wall until remedial goals are met. No other institutional requirements are expected at this time.	Deed restrictions may be necessary for groundwater areas upgradient of the PRB (if not installed along the waste boundary). No other institutional requirements are expected at this time.	Deed restrictions may be necessary for groundwater areas upgradient of the phytoremediation area or TreeWell® system. No other institutional requirements are expected at this time.

Table 4
Remedy Evaluation Summary
Draft Remedy Selection Report
Plant Yates AP-3, A, B, B', and R6 CCR Landfill
Georgia Power Company

Corrective Measure *Retained/ Screened Out*	**Geochemical Manipulation (In-Situ Injection)** *Retained*	**Hydraulic Containment** *Retained as an Option for Adaptive Management*	**In-Situ Stabilization/Solidification (ISS)** *Screened Out*	**Monitored Natural Attenuation** *Retained*	**Subsurface Vertical Barrier Walls** *Screened Out*	**Permeable Reactive Barrier** *Screened Out*	**Phytoremediation** *Retained as an Option for Adaptive Management*
Other Environmental or Public Health Requirements	None expected at this point. Based on downgradient sampling results near adjacent waterbodies, there currently appear to be no potential receptors downgradient of the units.	Based on downgradient sampling results near adjacent waterbodies, there currently are no complete receptor pathways downgradient of the units. Aboveground treatment components may need to be present for an extended period, generating residuals requiring management and disposal.	None expected at this point. Based on downgradient sampling results near adjacent waterbodies, there currently appear to be no potential receptors downgradient of the unit. Following implementation of ISS, this source control remedy is passive, does not create carbon emissions, and preserves groundwater resources.	Little to no physical disruption to remediation areas and no adverse construction-related impacts are expected on the surrounding community. Based on downgradient sampling results near adjacent waterbodies, there currently are no complete receptor pathways downgradient of the units.	Based on downgradient sampling results near adjacent waterbodies, there currently appear to be no potential receptors downgradient of the unit. Due to the potential need for groundwater extraction associated with barrier walls, aboveground treatment components may need to be present for an extended period, creating carbon emissions and generating residuals requiring management and disposal.	None expected at this point. Based on downgradient sampling results near adjacent waterbodies, there currently are no complete receptor pathways downgradient of the unit. Following installation, the remedy is passive.	None expected at this point. Based on downgradient sampling results near adjacent waterbodies, there currently are no complete receptor pathways downgradient of the units. Innovative and green technology may be positively received by various stakeholders. Following installation, the remedy is passive and does not require external energy.
Relative Costs and Screening							
Relative Costs	Moderate costs are associated with this technology.	High costs are associated with this technology (O&M and groundwater disposal).	High costs are associated with this technology.	Relatively lower capital costs are associated with this technology.	High capital costs are associated with this technology.	High capital costs are associated with this technology.	Relatively lower costs are associated with this technology. May require periodic harvesting and disposal of plant species.
Retaining Technology for Further Evaluation?	Yes	Yes. Hydraulic containment is not included in the alternatives because it would provide little incremental value to reduce the current extent of selenium above GWPS outside the waste boundary given the predicted gradients of the AEM drain operation (Appendix C). However, the technology is still reliable and applicable and is retained for adaptive management should it be applicable to future conditions.	No. ISS technology would be difficult to impractical to implement at the scale of the AMA and R6 landfill.	Yes	No. Site-specific hydrogeology limits implementability, performance, and effectiveness.	No. Site-specific hydrogeology limits implementability, performance, and effectiveness.	Yes. Hydraulic containment is not included in the alternatives because it would provide little incremental value to reduce the current extent of selenium above GWPS outside the waste boundary given the predicted gradients of the AEM drain operation (Appendix C). However, the technology is still reliable and applicable and is retained for adaptive management should it be applicable to future conditions.

Notes:
AMA = Ash Management Area
CCR = Coal Combustion Rule
CFR = Code of Federal Regulations
GWPS = Groundwater Protection Standard
MNA = monitored natural attenuation
NPDES = National Pollutant Discharge Elimination System
O&M = operation and maintenance
PRB = permeable reactive barrier
UIC = underground injection control

Figures



LEGEND

APPROXIMATE PROPERTY BOUNDARY

PERMITTED UNIT BOUNDARY

NOTE:
AERIAL IMAGE SOURCES: JANUARY 10, 2022 IMAGERY FLOWN AND PROCESSED BY SAM LLC; NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 650 1,300 2,600
GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

SITE LOCATION MAP

ARCADIS

FIGURE
1

LEGEND

- AREA WHERE ASH HAS BEEN CERTIFIED REMOVED AS OF 2/28/2022
- PERMITTED UNIT BOUNDARY
- PLANNED EXTENT OF AMA FINAL COVER
- EXISTING LIMIT OF R6 FINAL COVER

ENGINEERING MEASURE, SUBSURFACE DRAIN FEATURES

- INSTALLED CLEANOUT
- INSTALLED PUMP RISER
- ENGINEERING MEASURE, SUBSURFACE DRAIN

NOTE:
AERIAL IMAGE SOURCES: JANUARY 10, 2022 IMAGERY FLOWN AND PROCESSED BY SAM LLC; NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 300 600 1,200
GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

MAP OF CCR UNIT CLOSURE ACTIVITIES

ARCADIS

FIGURE
2

LEGEND

- SAPROLITE NETWORK MONITORING WELL LOCATION
- TRANSITION NETWORK MONITORING WELL LOCATION
- BEDROCK NETWORK MONITORING WELL LOCATION
- SAPROLITE NON-NETWORK WELL/PIEZOMETER
- TRANSITION NON-NETWORK WELL/PIEZOMETER
- BEDROCK NON-NETWORK WELL/PIEZOMETER
- PERMITTED UNIT BOUNDARY
- ENGINEERING MEASURE, SUBSURFACE DRAIN

NOTES:

1. YGWC-24SA AND PZ-24IA WERE ABANDONED ON MAY 25, 2022 TO ACCOMMODATE ROAD RE-ALIGNMENT CONSTRUCTION WORK ON DYER ROAD.
2. AERIAL IMAGE SOURCES: JANUARY 10, 2022 IMAGERY FLOWN AND PROCESSED BY SAM LLC; NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 350 700 1,400

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

WELL LOCATION MAP

ARCADIS

FIGURE
3

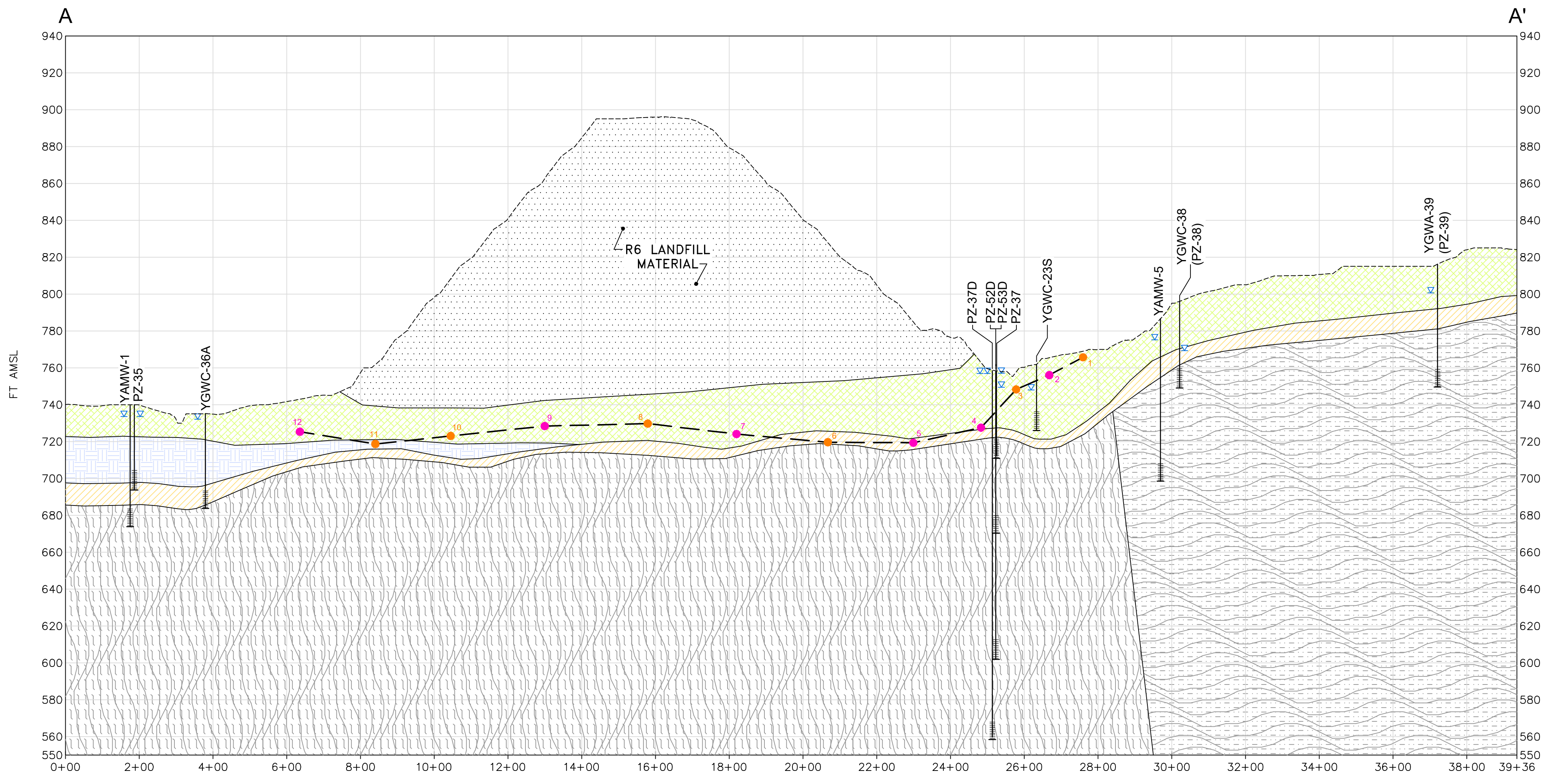
Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

CROSS-SECTION LOCATION MAP

ARCADIS

FIGURE
4



LEGEND:

- WATER ELEVATION (FEBRUARY 2022)
- WELL SCREEN
- ENGINEERING MEASURE, SUBSURFACE DRAIN
- INSTALLED PUMP RISER
- INSTALLED CLEANOUT

SAPROLITE:

- SILTY SAND – LIGHT BROWN TO TAN FINE–MEDIUM GRAINED SAND WITH SILT. LOOSE
- CLAYEY SAND – MOTTLED TO BROWN, FINE TO MEDIUM GRAINED SAND WITH CLAY. LOOSE.

TRANSITION ZONE:

- HIGHLY WEATHERED AND HIGHLY FRACTURED BIOTITE GNEISS, GRANITIC GNEISS, AND MICA SCHIST. FINE TO COARSE SAND AND GRAVEL PRESENT

BEDROCK:

- BEDROCK (UNDIFFERENTIATED) – UNDIFFERENTIATED BIOTITE GNEISS, GRANITIC GNEISS, AND MICA SCHIST. MODERATELY TO INTENSELY FOLIATED
- BIOTITE GNEISS – BIOTITE AND MUSCOVITE GNEISS. MODERATELY TO INTENSELY FOLIATED

NOTE:

1. CROSS SECTION ELEVATIONS ARE MEASURED IN FEET ABOVE MEAN SEA LEVEL (AMSL).

0 400' 800'
HORIZONTAL GRAPHIC SCALE

0 80' 160'
VERTICAL GRAPHIC SCALE

Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

CROSS-SECTION A-A'

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FIGURE
5

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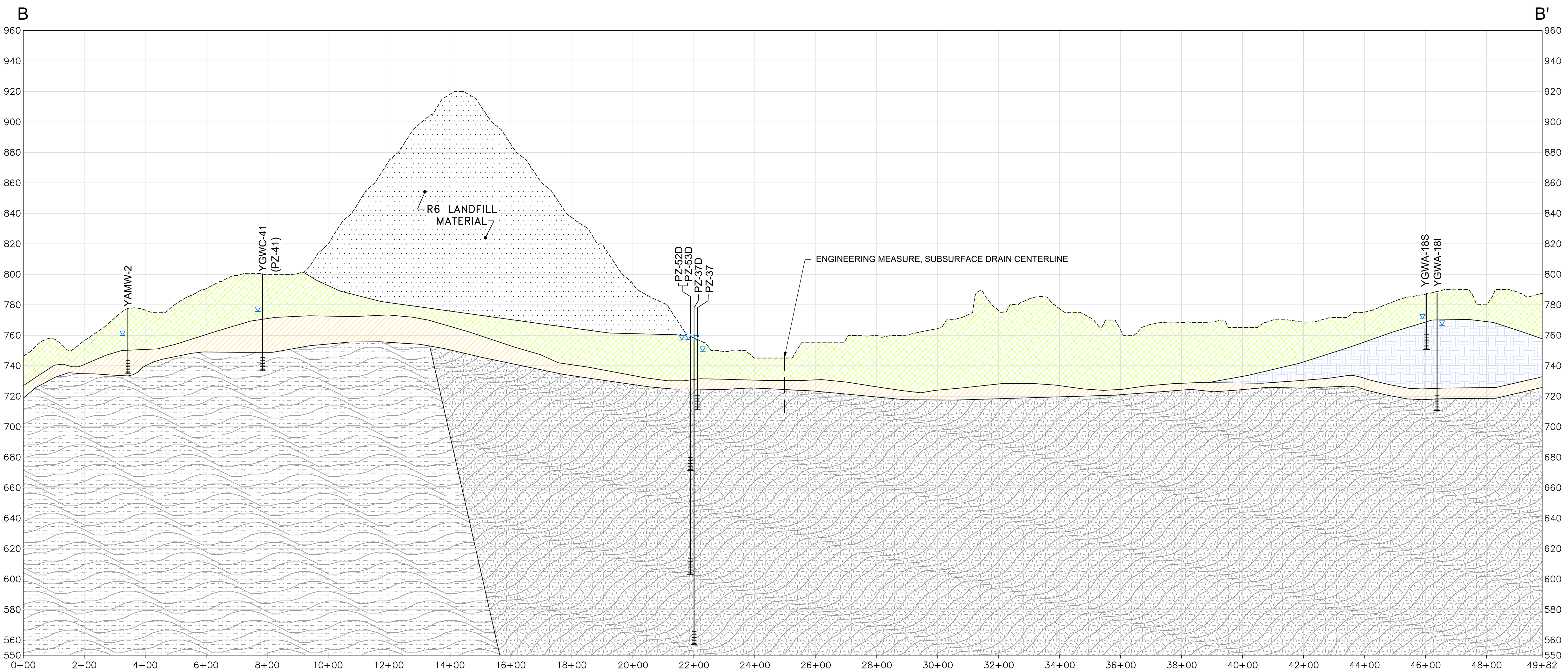
IMAGES: gp-logo.png
XREFS: X-GP-DRAFT-D



LEGEND:

- WATER ELEVATION (FEBRUARY 2022)
- WELL SCREEN
- ENGINEERING MEASURE, SUBSURFACE DRAIN
- INSTALLED PUMP RISER
- INSTALLED CLEANOUT

SAPROLITE:

- SANDY SILT– LIGHT BROWN TO BROWN SANDY SILT. LOW PLASTICITY
- SILTY SAND – LIGHT BROWN TO TAN FINE–MEDIUM GRAINED SAND WITH SILT. LOOSE
- CLAYEY SAND – MOTTLED TO BROWN, FINE TO MEDIUM GRAINED SAND WITH CLAY. LOOSE.

TRANSITION ZONE:

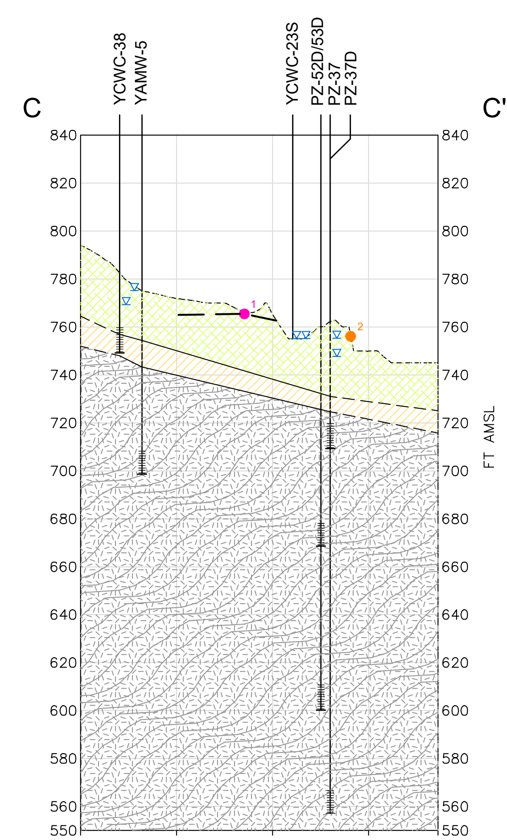
- HIGHLY WEATHERED AND HIGHLY FRACTURED BIOTITE GNEISS, GRANITIC GNEISS, AND MICA SCHIST. FINE TO COARSE SAND AND GRAVEL PRESENT

BEDROCK:

- GRANITIC GNEISS –GRAY TO WHITE, BIOTITE, MUSCOVITE, QUARTZ, PLAGIOCLASE GNEISS. MODERATELY TO INTENSELY FOLIATED
- BIOTITE GNEISS – BIOTITE AND MUSCOVITE GNEISS. MODERATELY TO INTENSELY FOLIATED

NOTE:

1. CROSS SECTION ELEVATIONS ARE MEASURED IN FEET ABOVE MEAN SEA LEVEL (AMSL).



0 400' 800'
HORIZONTAL GRAPHIC SCALE

0 80' 160'
VERTICAL GRAPHIC SCALE

Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

CROSS-SECTIONS B-B' AND C-C'

ARCADIS

FIGURE
6

C:\Users\kdavis\ACCDocs\Arcadis\AUS-GEORGIA POWER-PLANT YATES-NEWNAN Georgia\Project Files\2022\01-In Progress\01-DWG\GW-F05-F06-XSECT A-B-C.dwg LAYOUT: 6 SAVED: 8/10/2022 10:06 AM ACADVER: 24.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 8/25/2022 2:39 PM BY: DAVIS, KATHI
IMAGES: gp-logo.png
XREFS: X-GP-DRAFT-D

LEGEND

- SAPROLITE NETWORK MONITORING WELL LOCATION
- TRANSITION NETWORK MONITORING WELL LOCATION
- BEDROCK NETWORK MONITORING WELL LOCATION
- SAPROLITE NON-NETWORK WELL/PIEZOMETER
- TRANSITION NON-NETWORK WELL/PIEZOMETER
- BEDROCK NON-NETWORK WELL/PIEZOMETER
- PERMITTED UNIT BOUNDARY
- APPROXIMATE POTENTIOMETRIC CONTOUR (FEET) DASHED WHERE INFERRED
- GROUNDWATER FLOW DIRECTION
- 757.11 GROUNDWATER ELEVATION (FEET)
- ENGINEERING MEASURE, SUBSURFACE DRAIN

NOTES:

1. SHALLOW GROUNDWATER ELEVATIONS ARE DERIVED FROM SOIL COMPRISED OF SAPROLITE, RANGING FROM 15 - 60 FEET BELOW GROUND SURFACE.
2. BEDROCK WELLS YGWA-40, YGWA-39, YGWC-38, YGWC-41, YGWC-42 USED FOR CONTOURING. ALL OTHER BEDROCK WELLS NOT USED TO CREATE CONTOURS.
3. SAPROLITE WELL GROUNDWATER ELEVATIONS WERE USED FOR CONTOURING FOR SAPROLITE/TRANSITION ZONE/BEDROCK WELL CLUSTER LOCATIONS.
4. AERIAL IMAGE SOURCES: JANUARY 10, 2022 IMAGERY FLOWN AND PROCESSED BY SAM LLC; NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.
5. ELEVATION IS PRESENTED IN U.S. SURVEY FEET (NAVD 1988).
6. GROUNDWATER ELEVATIONS COLLECTED ON FEBRUARY 7, 2022.

0 350 700 1,400

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

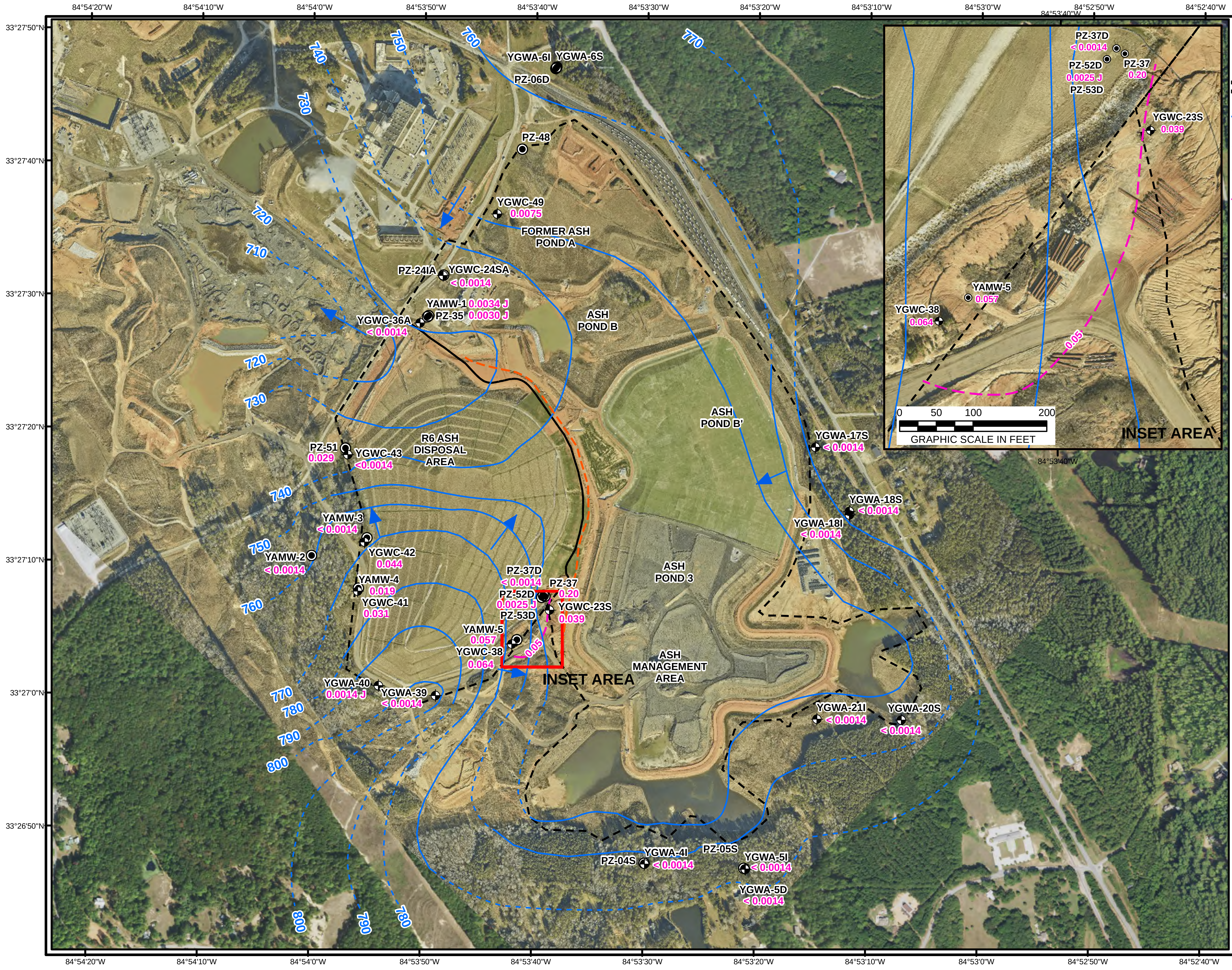
Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

GROUNDWATER ELEVATION MAP
FEBRUARY 2022

ARCADIS

FIGURE
7



LEGEND

- MONITORING WELL LOCATION
- NON-NETWORK WELL/PIEZOMETER
- PERMITTED UNIT BOUNDARY
- APPROXIMATE POTENTIOMETRIC CONTOUR (FEET) DASHED WHERE INFERRED
- GROUNDWATER FLOW DIRECTION
- ENGINEERING MEASURE, SUBSURFACE DRAIN
- SELENIUM ISOCONTOUR LINE (DASHED WHERE INFERRED)

SELENIUM GROUNDWATER PROTECTION STANDARD VALUE = 0.050 mg/L

0.046 SELENIUM CONCENTRATION VALUES (mg/L)

NOTES:
1. RESULTS ARE PROVIDED IN MILLIGRAMS PER LITER (mg/L)
2. J = ESTIMATED VALUE
3. SAMPLES WERE COLLECTED ON FEBRUARY 8 – 11, 2022.
4. APPROXIMATE POTENTIOMETRIC CONTOURS DATED FEBRUARY 7, 2022.
5. AERIAL IMAGE SOURCES: JANUARY 10, 2022 IMAGERY FLOWN AND PROCESSED BY SAM LLC; NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 350 700 1,400

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

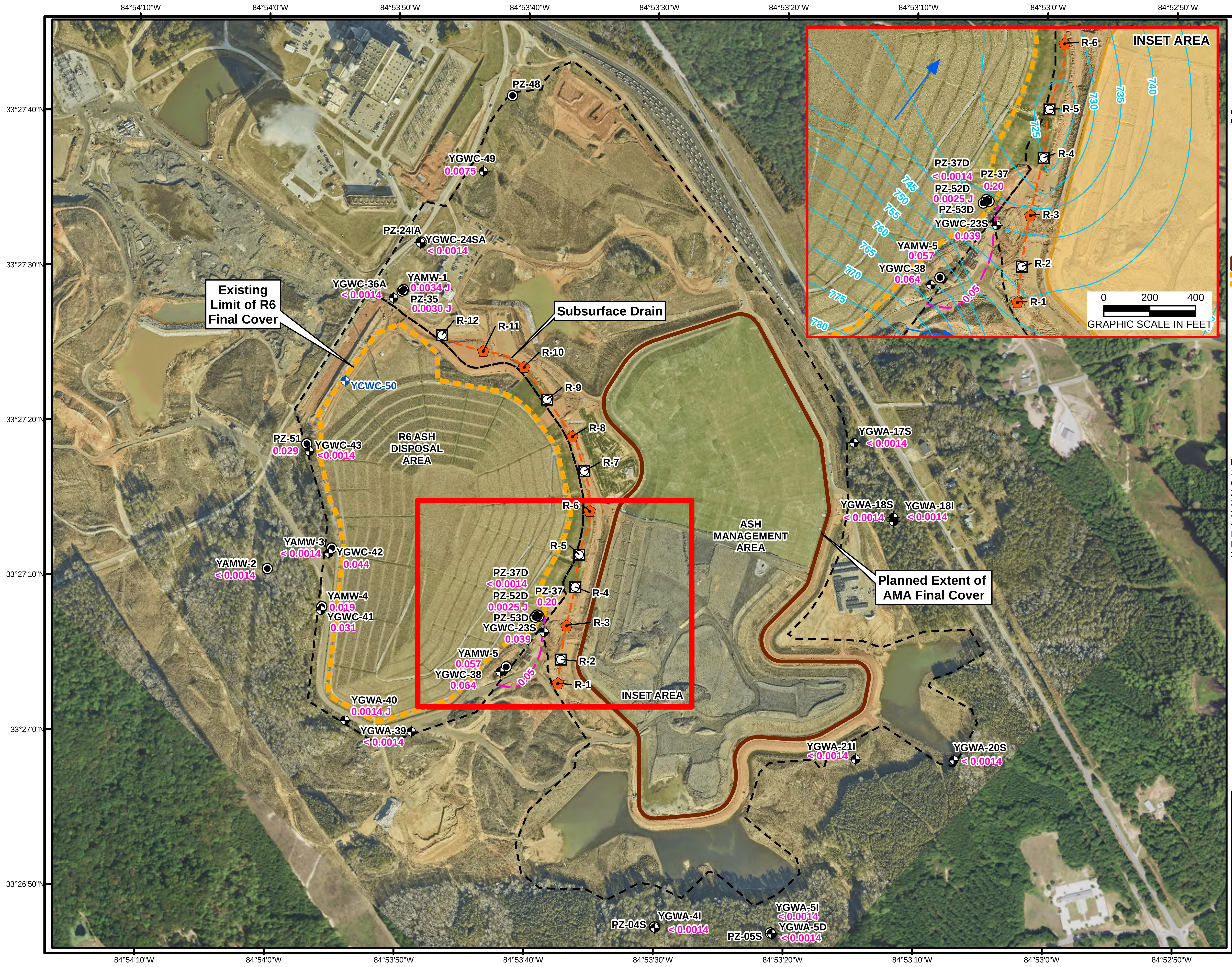
Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

SELENIUM ISOCONCENTRATION MAP, FEBRUARY 2022

ARCADIS

FIGURE
8



LEGEND

- MONITORING WELL LOCATION
- NON-NETWORK WELL/PIEZOMETER
- PROPOSED MONITORING WELL LOCATION
- PERMITTED UNIT BOUNDARY
- PREDICTED POTENTIOMETRIC SURFACE CONTOURS WITH OPERATION OF THE AEM DRAIN, MODEL LAYER 3
- GROUNDWATER FLOW DIRECTION
- SELENIUM ISOCONTOUR LINE (DASHED WHERE INFERRED)

SELENIUM GROUNDWATER PROTECTION STANDARD VALUE = 0.050 mg/L

0.046 SELENIUM CONCENTRATION VALUES (mg/L)

- PLANNED EXTENT OF AMA FINAL COVER
- EXISTING LIMIT OF R6 FINAL COVER

ENGINEERING MEASURE SUBSURFACE DRAIN FEATURES

- INSTALLED CLEANOUT
- INSTALLED PUMP RISER
- ENGINEERING MEASURE, SUBSURFACE DRAIN

NOTES:

1. RESULTS ARE PROVIDED IN MILLIGRAMS PER LITER (mg/L)
2. J = ESTIMATED VALUE
3. SAMPLES WERE COLLECTED ON FEBRUARY 8 – 11, 2022.
4. AERIAL IMAGE SOURCES: JANUARY 10, 2022 IMAGERY FLOWN AND PROCESSED BY SAM LLC; NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 300 600 1,200

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

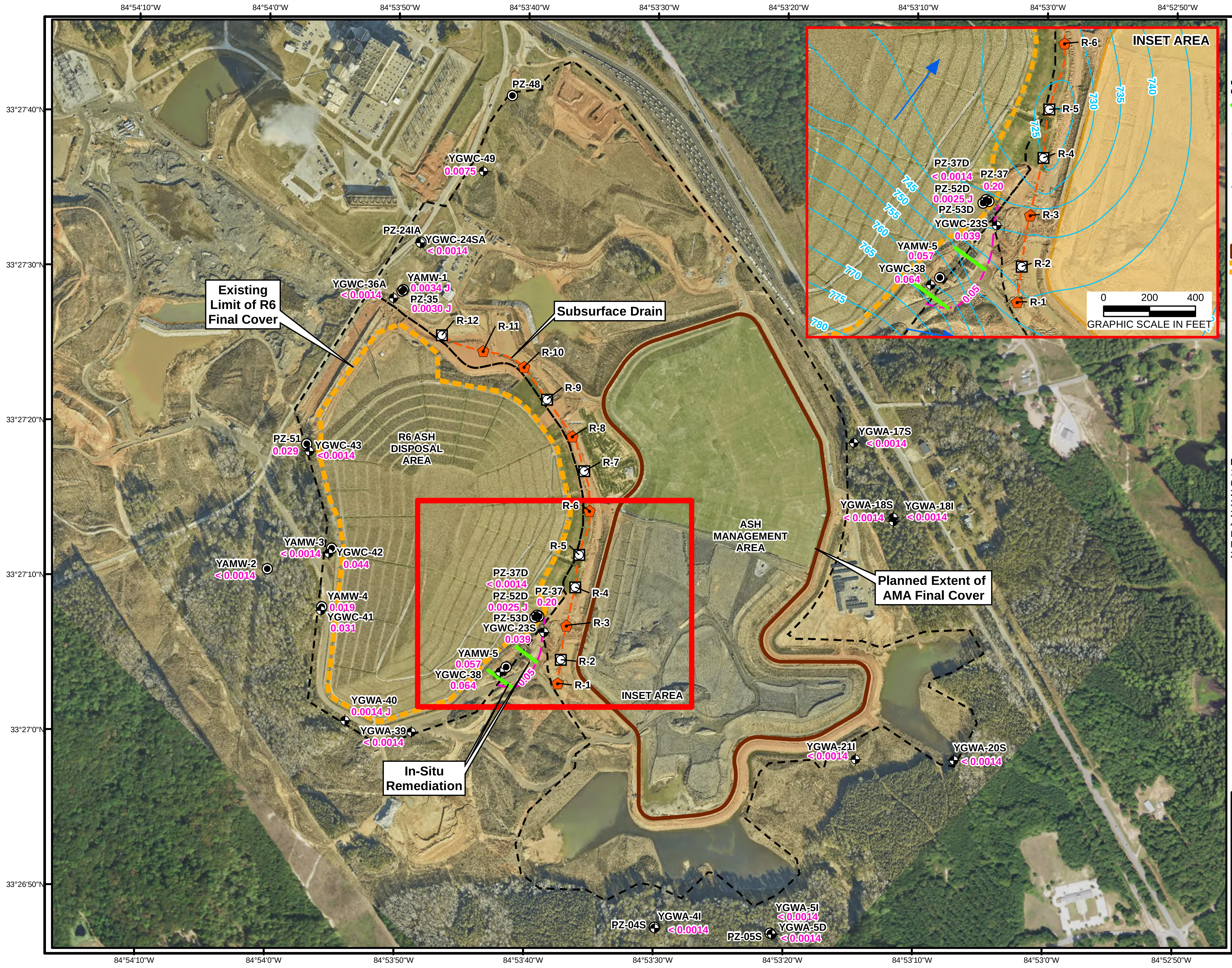
PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

REMEDIAL ALTERNATIVE 1: MNA

ARCADIS

FIGURE

9



LEGEND

- MONITORING WELL LOCATION
- NON-NETWORK WELL/PIEZOMETER
- PERMITTED UNIT BOUNDARY
- IN SITU TRANSECT
- PREDICTED POTENTIOMETRIC SURFACE CONTOURS WITH OPERATION OF THE AEM DRAIN, MODEL LAYER 3
- GROUNDWATER FLOW DIRECTION
- SELENIUM ISOCONTOUR LINE (DASHED WHERE INFERRED)

SELENIUM GROUNDWATER PROTECTION STANDARD VALUE = 0.050 mg/L

0.046 SELENIUM CONCENTRATION VALUES (mg/L)

- PLANNED EXTENT OF AMA FINAL COVER
- EXISTING LIMIT OF R6 FINAL COVER

ENGINEERING MEASURE SUBSURFACE DRAIN FEATURES

- INSTALLED CLEANOUT
- INSTALLED PUMP RISER
- ENGINEERING MEASURE, SUBSURFACE DRAIN

NOTES:
1. RESULTS ARE PROVIDED IN MILLIGRAMS PER LITER (mg/L)
2. J = ESTIMATED VALUE
3. SAMPLES WERE COLLECTED ON FEBRUARY 8 – 11, 2022.
4. AERIAL IMAGE SOURCES: JANUARY 10, 2022 IMAGERY FLOWN AND PROCESSED BY SAM LLC; NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 300 600 1,200
GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
DRAFT REMEDY SELECTION REPORT

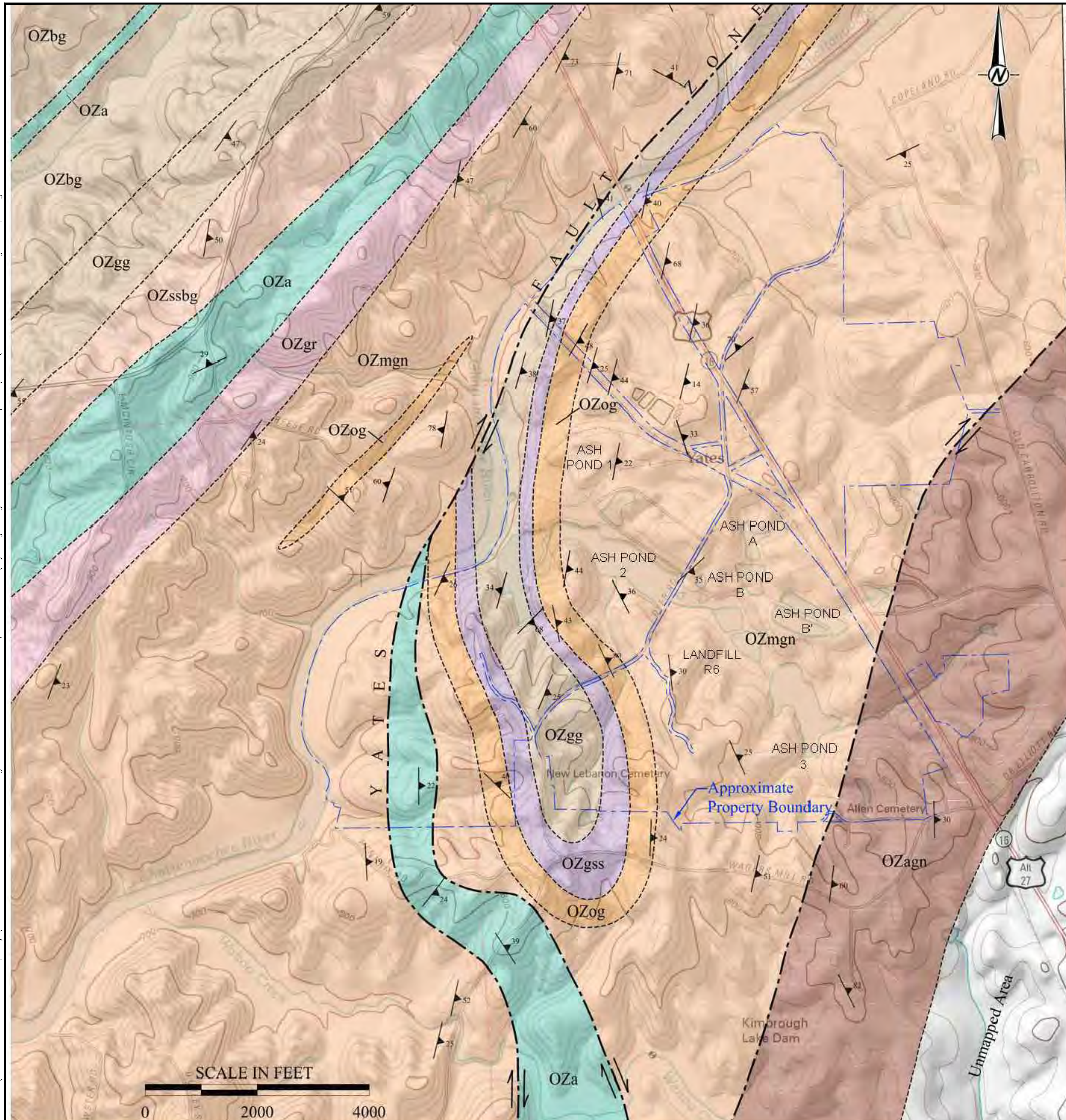
REMEDIAL ALTERNATIVE 2: ISI

ARCADIS

FIGURE
10

Appendix A

Excerpt from Geologic Mapping and Lineament Analysis (Golder 2017)



NOTE: THIS DRAWING WAS PREPARED BY GOLDER ASSOCIATES, INC. FOR THE GEOLOGIC MAPPING AND LINEAMENT ANALYSIS GEORGIA POWER PLANT YATES, DATED OCTOBER 6, 2017. GEOLOGIC MAPPING WAS CONDUCTED BY PETROLOGIC SOLUTIONS, INC.

DESCRIPTION OF MAP UNITS

OZbg — ***Biotite Gneiss-*** garnet (small, minor)-muscovite-biotite-quartz-feldspar gneiss, fine- to medium-grained, schistose in part; interlayered with garnet (small, minor)-biotite-feldspar-quartz-muscovite schist, medium- to coarse-grained; some garnet-rich zones, all layereded with concordant and discordant pegmatite pods, lenses, and layers up to 10 feet thick; foliation wraps around pegmatite pods/lenses.

OZa — ***Amphibolite-*** amphibole/hornblende gneiss, thinly laminated, fine- to medium-grained hornblende and plagioclase; and chlorite-actinolite schist, very fine-grained; joints are close-spaced and abundant.

OZgg — ***Granitic-Gneiss-*** biotite-quartz-feldspar gneiss, very feldspathic; quartz and feldspar are medium- to coarse-grained; biotite is fine- to medium-grained. Muscovite is present where this gneiss is sheared. Shear foliation is commonly developed.

OZssbg — ***Biotite Gneiss and Sillimanite Schist-*** biotite-quartz-feldspar gneiss; interlayered with sillimanite, garnet, quartz, muscovite schist. Shear foliation is commonly developed.

OZog — ***Orange Gneiss-*** well layered, well foliated, moderately jointed, fine- to medium-grained, biotite-quartz-feldspar gneiss; this unit weathers fairly deeply relative to adjacent lithologies, forming a distinctive dark red, vermiculitic soil from weathering of biotite; the gneiss locally contains thin lenses of chlorite-actinolite schist and feldspar-hornblende gneiss/amphibolite, increasing in concentration of these ultramafic and mafic bodies to the southeast.

OZgr — ***Granite-*** generally massive, weakly foliated, poorly jointed, fine- to medium-grained, light-gray, large exfoliation boulders are common.

OZmgn — ***Migmatitic Gneiss-*** highly contorted, well layered, well foliated, poorly jointed, medium-grained muscovite-biotite-quartz-feldspar migmaticitc gneiss. Granite is locally interlayered with biotite gneiss and pods/lenses of ultramafic bodies, which occur as relatively fresh, well foliated, unjointed boulders of medium- to course-grained actinolite-chlorite schist..

OZgss — ***Sillimanite Staurolite Garnet Schist-*** sillimanite-staurolite-garnet-biotite-quartz-muscovite schist, medium- to coarse-grained, sheared; staurolite and garnet are porphyroblastic, biotite and quartz content are highly variable, generally poorly weathered.

OZagn — ***Porphyroclastic Augen Gneissic-*** muscovite-biotite-quartz-feldspar gneissic granite, feldspathic; quartz and feldspar are medium- to coarse-grained; feldspar phenocrysts form porphyroclasts, biotite is fine- to medium-grained.

EXPLANATION OF MAP SYMBOLS

- Lithologic unit contact- Approximate location
- Fault (high angle)- Approximate location
- Fault (strike/slip)- Approximate location
- Strike and Dip of Foliation (65)

REFERENCES

1. USGS 7.5 Minute Quadrangles, Whitesburg, 2011.
2. Property Boundary provided by Coweta County GIS Department, 2015.

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Roswell, GA 30075
o 770.594.5998
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PROJECT:

PLANT YATES HYDROGEOLOGIC ASSESSMENT

708 DYER ROAD
NEWNAN, GEORGIA

REVISIONS

Drawn by: MM | Checked by: JF

PROJECT NUMBER: I054-110

March 2020

PLANT YATES GEOLOGIC MAP

FIGURE 4

P:\Industrial\1054 – Southern Company\110 – Groundwater Consulting Services 2018 – 2021\Plant Yates\Hydrogeologic Assessment Report\DWG\Plant Yates Geologic Map.dwg 2019-09-05 MATT MALONE

Appendix B

Geochemical Conceptual Site Model

Geochemical Conceptual Site Model Report

Plant Yates – R6 CCR Landfill
Newnan, Georgia

August 31, 2022

Geochemical Conceptual Site Model

Georgia Power Company
Newnan, Georgia
Coweta County

August 31, 2022

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Technical Expert (Eng) / Project Manager

Contents

Tables

Figures

Attachment

Acronyms and Abbreviations

Arcadis	Arcadis, Inc.
bgs	below ground surface
CCR	Coal Combustion Residuals
CSM	conceptual site model
Eh	electron potential
ft	feet
g	grams
GWPS	Groundwater Protection Standard
ICP-MS	inductively coupled plasma-mass spectrometry
Kd	sorption coefficient
L/Kg	liter per kilogram
mL	milliliter
mg/L	milligram per liter
mV	millivolt
ORP	oxidation-reduction potential
SeO_3^{2-}	selenite
SeO_4^{2-}	selenate
SSL	statistically significant level
TDS	total dissolved solids
XRD	x-ray diffraction

1 Introduction

This Geochemical Conceptual Site Model (CSM) Report describes the current understanding of geochemical conditions and factors affecting the fate and transport of selenium in groundwater. The information presented in this CSM report is intended to support remedy selection and transport modeling at Plant Yates R6 Coal Combustion Residual (CCR) Landfill (the site) and includes data and analysis of:

- General conditions (aquifer matrix composition, pH and redox conditions, major ion chemistry, and concentration trends); and
- Fate and transport of selenium (selenium geochemistry, selenium speciation, and selenium sorption evaluation)

2 General Conditions

2.1 Aquifer Matrix Composition

In 2020, aquifer matrix solids were collected from the saprolite unit and the underlying fractured gneiss bedrock to evaluate the mineralogy and phases affecting the fate and transport of selenium. Subsurface materials were collected from discrete core intervals from monitoring locations YGWC-38, YGWC-41,YGWC-24SA, YAMW-3, and YAMW-4 and submitted for mineralogy by semi-quantitative x-ray diffraction (XRD), and elemental assay. Analytical laboratory reports are provided in Attachment 1. A total of 11 samples were collected from the five locations (Table 2.1) representing the following lithologies:

- Saprolite: YGWC-24SA (three depth intervals) and YGWC-38 (one interval);
- Partially weathered rock: YGWC-41 (two intervals);
- Gneiss: YAMW-3 and YAMW-4 (one interval each);
- Biotite Gneiss: YGWC-38 (two intervals) and YGWC-41 (one interval).

The target depth intervals were selected to represent the overall depth profiles within each boring, such as unsaturated material, saturated or partially-saturated material just above the screened interval, and saturated material within the screened interval.

Table 2.1 presents XRD mineralogy results, identifying the dominant mineral assemblages and chemical balance of individual constituents in the saprolite, partially weathered bedrock, and bedrock units. Specifically, this analysis was completed to identify and evaluate the mineral phases that support attenuation of selenium.

The saprolite material contains mainly quartz and plagioclase feldspar minerals (albite and albite, calcian) accounting for more than 70 percent of the composition. Quartz occurs mostly in the range of 40 to 52 weight percent. Plagioclase feldspars occur in significant amounts ranging from 33 to 38 weight percent. Micas (muscovite and biotite) make up the next most dominant mineral group. Together, the mineralogical assemblage reflects a mafic (iron and magnesium-rich) nature of the underlying rocks. The plagioclase feldspar and mica minerals are important to the CSM because, as weathering of the saprolite progresses, the plagioclase feldspar, muscovite and biotite along with other silicates weather to form clays, which are present mainly in the form of kaolinite and other minor clay minerals (**Table 2.1**). The formation of secondary minerals, such as clays and aluminum and iron oxides, provides sorption capacity for constituents such as selenium.

Similarly, the mineralogy of the partially weathered rock at YGWC-41 is dominated by quartz and plagioclase feldspar minerals, accounting for more than 85 percent of the overall composition. Of the mica minerals that make up the next largest component, muscovite and hydrated biotite are abundant in the interval from 32 to 33 feet below ground surface [(ft bgs), and biotite and muscovite are abundant in the interval from 48 to 49 ft bgs. The abundance of biotite is consistent with the magnesium-dominant water observed at YGWC-41 and YGWC-42 (see Section 2.3, below).

The distinction between gneiss and biotite gneiss on the boring logs is based on the visual observation of the abundance of biotite. However, the mineralogical data suggest these lithologies are the same and therefore, are discussed together (**Table 2.1**). Quartz and plagioclase feldspar are the dominant minerals in the bedrock unit, with a substantial presence of micas (muscovite and biotite), which account for up to 12 percent of the overall composition. In the sample interval collected from the screened interval at YAMW-4, clinochlore (magnesium-bearing mineral in the chlorite group) was also present. Secondary minerals associated with the weathering of micas were not present in measurable abundance in the samples collected; however, it can be reasonably assumed that weathering products, that is clay minerals, occur within larger bedrock fractures.

Table 2.2 provides a summary of the elemental assay results, which were calculated from the mineral formulas and quantities identified by XRD analysis. The magnesium content was greater than that of calcium (in weight percent) in the samples collected from YGWC-41, YAMW-3, and YGWC-24SA along the western boundary of the R6 CCR Landfill. In contrast, the calcium content was much greater than the magnesium content in samples collected from the screened interval at YGWC-38 (59.5-60.5 ft bgs), located southeast of R6. The presence and abundance of aluminum and iron in the assay results suggest a strong potential for secondary aluminum and iron oxides to form during weathering processes, which are phases known to contain attenuation capacity for trace constituents. These observations are consistent with boring log descriptions, which detail reddish brown and pale yellow weathering zones within the saprolite and partially weathered rock. These descriptive terms are commonly reported when describing subsurface material containing aluminum and iron oxides.

In summary, the aquifer matrix reflects a mafic rock composition with abundant iron and aluminum, which weather to form aluminum and iron oxide phases known to contain attenuation capacity for trace constituents. In addition, clay minerals formed from the weathering of plagioclase feldspar, muscovite and biotite, and silicate minerals in the saprolite and PWR further support attenuation in the aquifer.

2.2 pH and Redox Conditions

Groundwater pH and reduction-oxidation (redox) conditions summarized in this section affects properties of the aquifer minerals and the speciation of selenium that ultimately govern the fate and transport of selenium. Selenium is redox reactive and forms different species (selenate, selenite, elemental selenium, and selenide) as a function of redox conditions and pH. Selenium mobility and attenuation is a function of which species is present as well as other water quality and aquifer mineral properties. For instance, surface charge of mineral surfaces is affected by pH, which affects whether and how strongly the surface would interact with selenium species, such as the negatively charged selenate and selenite.

Field parameters collected during groundwater sampling events including pH, dissolved oxygen and oxidation-reduction potential (ORP) data are tabulated in **Table 2.3** to provide a broad indication of redox conditions. Additional characterization of redox conditions was conducted during a supplemental sampling event in October 2019 included evaluation of additional redox processes via measurement of nitrate, ferric and ferrous iron, manganese, and total organic carbon. Results are presented in **Table 2.3**.

Figure 2.1 presents the dissolved oxygen concentrations, and **Figure 2.2** presents the pH and Eh data, which are calculated from the field ORP value and corrected for the silver-silver chloride electrode (Ag/AgCl).The conditions in groundwater at the R6 CCR Landfill monitoring network wells are generally oxidizing and mildly acidic, while dissolved oxygen varies with location and time. As shown on **Figure 2.2**, the Eh conditions at upgradient wells YGWA-39 and YGWA-40 are similar, in the range from 200 to 450 millivolts (mV). However, the pH varies in these upgradient wells; groundwater at YGWA-40 is slightly more acidic (pH 4.75 to 5.84) with higher dissolved oxygen than YGWA-39 (pH 5.54 to 7.22). Wells with elevated selenium (YGWC-38, YGWC-41, and PZ-37) generally yield pH less than 5.5 and show a range of dissolved oxygen concentrations from less than 1 milligram per liter (mg/L) up to 5.72 mg/L.

While field probe data can be subject to variability, and trends should therefore not be overly interpreted, the dataset presented here provides some indications of changing redox conditions since R6 CCR Landfill closure. Dissolved oxygen and Eh trends are plotted on **Figure 2.3**. Dissolved oxygen concentrations increased up to above 4 mg/L at YGWC-38 and YGWC-41 since closure was complete in fourth quarter 2016, while more modest increases were observed at PZ-37 and YGWC-42. General increasing trends in Eh were observed at YGWC-38, PZ-37, and YGWC-41, although there were readings that were exceptions to these trends observed.

The supplemental redox data collected in October 2019 showed that conditions are not metal reducing at upgradient well YWGA-40 and R6 CCR Landfill wells YGWC-38, YGWC-41, and YGWC-42 with non-detect to 0.35 mg/L iron (total, ferric, and ferrous), manganese less than 0.12 mg/L, non-detect sulfide, and non-detect total organic carbon. **Figure 2.4** provides an Eh/pH diagram for iron. The plot indicates that iron oxides (e.g. goethite) are thermodynamically favored under site conditions for YWGA-40, YGWC-38, YGWC-41 and YGWC-42, consistent with the analytical data. Iron oxides are a potential sorbent for selenate and selenite. Potential iron reducing conditions were observed at downgradient well YGWC-43, with an elevated total iron concentration of 26 mg/L measured, consistent with a dissolved oxygen concentration of 0.06 mg/L in October 2019 and a slightly lower range of redox potentials as shown on **Figure 2.2**, although the speciation data indicated the majority of the iron was ferric iron (Table 2.3). The analytical data indicates reduced Fe2+ is likely present. The Eh/pH diagram (**Figure 2.4**) indicates conditions where goethite would predominate, but the Eh is relatively low compared to other site data and toward the boundary of the Fe^{2+} stability field where there would also be Fe^{2+} present.

2.3 Major Ion Chemistry

In October 2019 and August-September 2021, sampling and analysis included an expanded analyte list to cover major cations, anions, and alkalinity species. The results are presented in Piper and Stiff diagrams. **Figure 2.5** is a Piper diagram displaying the relative composition of major ion chemistry in groundwater across the site. **Figure 2.5** shows predominantly a calcium-magnesium-sulfate type groundwater for most of the downgradient wells. Upgradient wells YGWA-39 and YGWA-40 are close to the boundary of calcium-magnesium-sulfate type water, whereas downgradient well YGWC-36A is a sodium-chloride-sulfate-type water. This suggests that the downgradient groundwater at YGWC-36A is closer to the upgradient groundwater composition compared to other downgradient wells. **Figures 2.6A and B** show the major ion chemistry, presented as Stiff diagrams and grouped by location in the southeast and western boundaries, respectively. The Stiff diagrams are also shown in cross-section view to illustrate the spatial distribution of general water types. **Figure 2.7** is a cross-section location map and **Figures 2.8 and 2.9** present the cross-sectional views. The different water types in the locations in which SSLs of selenium (YGWC-38 and PZ-37) occur are very apparent by visual comparison of the Stiff diagrams.

2.4 Trend Analysis

Groundwater analytical data (through February 2022) are presented as time-series plots on **Figures 2.10 through 2.14** to illustrate how groundwater conditions are changing in conjunction with closure and attenuation processes (discussed in **Section 3**).

In the R6 CCR Landfill area, decreasing concentration trends are observed on the southeast side of the unit at YGWC-38 (**Figure 2.10**). At this location, concentrations of boron, sulfate, and total dissolved solids (TDS) have been decreasing through time, with concentrations of chloride and pH values remaining stable. For example, boron concentrations decreased from 22.7 mg/L in June of 2018 to 5.4 mg/L in February 2022. The concentration data indicate that target Appendix III constituent concentrations that are indicators for CCR constituents in groundwater are also decreasing near YGWC-38. Beryllium concentrations have decreased from a maximum of 0.0059 mg/L in June 2018 to 0.0027 mg/L in February 2022, lower than the GWPS of 0.004 mg/L. Selenium concentrations in YGWC-38 have also decreased from 0.265 mg/L in September 2017 to 0.064 mg/L in February 2022.

Similar decreasing trends are also noted spatially and vertically near YGWC-38. Preliminary data collected from YAMW-5 (**Figure 2.11)** suggest generally stable pH and chloride concentrations and potential decreasing concentrations of boron, sulfate, and TDS in the deeper aquifer zone adjacent to YGWC-38**.** Concentrations of selenium at YAMW-5 have increased from 0.026 mg/L to 0.061 mg/L, with the most recent (February 2022) measurement of 0.057 mg/L. Short-term perturbations in groundwater flow and geochemistry due to closure may cause temporary increases in constituent concentrations in some locations (e.g., YAMW-5).

Concentrations of boron, sulfate, and TDS have been decreasing over time at PZ-37 (**Figure 2.12**); chloride and pH trends are generally stable. Selenium concentrations in PZ-37 varied between 0.168 mg/L in January 2018 and approximately 0.33 mg/L in September 2018 and 2020, before decreasing to 0.20 mg/L in February 2022. To vertically delineate selenium in the vicinity of PZ-37, a deep bedrock well (PZ-52D) was installed in September 2021 at a depth shallower than PZ-37D. Concentrations of selenium at PZ-52D are very low, 0.002 mg/L in February 2022, at a depth of approximately 92 ft bgs (**Table 2.3**).

On the west side of the R6 CCR Landfill, boron, sulfate, and TDS concentrations have declined at YGWC-41 (**Figure 2.13**). For example, boron decreased from a maximum of 15.2 mg/L in February 2018 to 4.0 mg/L in February 2022. Concentrations of beryllium have decreased over time from 0.0039 mg/L (February 2018) to 0.0016 mg/L (February 2022). Similarly, selenium concentrations at YGWC-41 have decreased from a maximum of 0.071 mg/L in February 2018 to 0.031 mg/L in February 2022. Selenium concentrations are lower on the west side of the R6 CCR Landfill, as noted in wells YGWC-41 and YGWC-42, compared to YWGC-38 and PZ-37 on the east side of the unit.

Selenium concentrations in well YGWC-42 also decreased from the maximum concentration of 0.059 mg/L (October 2017) and stabilized over time, with the most recent measurement of 0.044 mg/L in February 2022. Concentrations of boron, sulfate, and TDS also decreased over time (**Figure 2.14**), with concentrations of chloride generally stable. Concentrations of boron have decreased from a maximum of 22.7 mg/L in April 2018 to 14.4 mg/L in February 2022. Concentrations of sulfate have similarly decreased from a maximum of 1,100 mg/L in October 2017 to 485 mg/L in February 2022.

In summary, groundwater monitoring data show declining trends in concentrations of CCR constituents, such as boron, sulfate, beryllium, and selenium, most likely due to closure progressing at the R6 CCR Landfill since 2016 and attenuation of constituents in groundwater.

3 Fate and Transport of Selenium

3.1 Selenium Geochemistry

Selenium is a redox reactive element found in groundwater primarily as selenite (SeO_3^{2-}), selenate (SeO_4^{2-}), elemental Se(0), or selenide. Selenium occurs in CCR material as selenium salts, SeO_3^{2-}, and SeO_4^{2-} (Zachara et al. 1994). The following discussion of the factors influencing the behavior of selenium is referenced from Zachara et al. (1994). The oxidation state of selenium affects solubility and mobility. Elemental selenium and metal selenides are relatively insoluble. SeO_3^{2-} and SeO_4^{2-} are relatively soluble and attenuate by sorption to iron and aluminum oxides and kaolinite. SeO_3^{2-} sorbs more strongly than SeO_4^{2-}. In the presence of sulfate, SeO_4^{2-} is more mobile and less likely to attenuate due to competition for sorption. Both SeO_4^{2-} and SeO_3^{2-} are anions and sorb more strongly at lower pH.

3.2 Selenium Speciation

The fate and transport of selenium in groundwater depends on the species of selenium present. The Eh/pH data for the R6 landfill monitoring wells for the R6 Landfill are plotted on a selenium speciation diagram using site specific data and verified with published selenium speciation diagrams from the literature (Su et al. 2007; **Figure 3.1**). The Eh/pH diagram indicates that, for the oxidizing, mildly acidic groundwater at the site, a species of selenite ($HSeO_3^-$), is predicted to be dominant, except for several samples from locations such as YGWC-41 and YGCW-43, where elemental selenium is predicted to be dominant.

Groundwater collected from YGWC-38 and YGWC-41 in September 2020, and PZ-37 in April 2022 was submitted for selenium speciation analysis to Brooks Applied Laboratories in Bothell, Washington, to determine the species present in groundwater at the site. Selenium speciation was analyzed using inductively coupled plasma-mass spectrometry (ICP-MS) and included total dissolved selenium, selenite, selenate, and other commonly observed forms of selenium. Results from the speciation of selenium in groundwater analysis are summarized in **Table 3.1**. The results demonstrate that selenium is present predominantly in the form of selenate, with a minor amount of selenite measured only at PZ-37. While selenate was not predicted in the typical thermodynamic model presented on **Figure 3.1**, the presence of selenate is consistent with the shift toward higher dissolved oxygen and ORP observed at YGWC-38 and YGWC-41 by September 2020, and PZ-37 by February 2022 (**Figure 2.3**) and may reflect actual conditions that are not at thermodynamic equilibrium represented by the speciation diagram. Deviations from thermodynamic equilibrium may be due to recent closure activities and are expected to trend toward equilibrium through time, with groundwater conditions favoring the attenuation of selenium species onto aluminum and iron oxides (**Section 3.4**).

3.3 Sorption Study

A bench-scale study was completed to evaluate the sorption of selenium in site groundwater onto site aquifer materials. The sorption study was completed as a direct measurement of sorption in lieu of assessment by selective extractions.

To assess the sorption mechanism, capacity, and stability of the aquifer matrix to attenuate dissolved selenium in groundwater, a series of bench-scale sorption tests were completed on the saprolite and bedrock solids identified in **Table 3.2**. The bench-scale sorption tests incorporated groundwater collected from YGWC-38, where the initial concentration of selenium was approximately 0.075 mg/L; total acidity was 22.2 mg/L; and samples representative of saprolite and gneiss bedrock. Saprolite material from above the saturated zone in YGWC-24SA was used to support the assessment of sorption capacity in unimpacted sediments. The biotite gneiss bedrock material, both fine- and coarse-grained, was generated from a core collected from YAMW-4 to represent unimpacted bedrock aquifer material. The bedrock cores were crushed into two particle size ranges using a proctor hammer and 0.375-inch and 0.1875-inch sieves. The coarse bedrock used in the reactors incorporated particle size ranges between 0.1875 and 0.375 inch. The fine bedrock material used were the particles passing through the 0.1875-inch sieve. The core processing and separation of course and fine-grained fractions was done to enable the measurement of sorption onto reactive surfaces likely present in the fine grained, although it should be recognized there is some uncertainty in how the absolute values of sorption measured would translate the undisturbed aquifer formation.

For each of the aquifer matrix samples evaluated (saprolite, biotite gneiss fine, and biotite gneiss coarse), several trials were run with variations in the solid to liquid ratio to measure the amount of sorption. Each reactor was run for a 72-hour period, after which a filtered sample was extracted and submitted for selenium analysis. In addition, a control reactor containing only YGWC-38 groundwater was run to verify that sorption to the reaction vessel did not occur. Over 72 hours, pH in the reactor cells varied depending on the solid-to-liquid ratio and material type. Results from each trial are presented in **Table 3.2**. In the saprolite unit and fine-grained bedrock, selenium sorption occurred when aquifer material (in grams [g]) to groundwater (in milliliters [mL]) ratios ranged from 1g:1mL to 3g:1mL with 11 to 43 percent selenium removal in the saprolite trials and 7 to 31 percent removed in the fine-grained bedrock trials.

The test can also be used to assess the capacity of aquifer materials for sorbing selenate under oxidizing conditions and high sulfate concentrations found at YGWC-38 and YGWC-41. No measurable sorption was observed when the saprolite and fine-grained bedrock fraction was loaded with more than 0.5 mg selenium/kg aquifer solids, indicating that sorption capacity was exceeded. When loaded with lower amounts of selenium, the saprolite capacity was 0.008 to 0.13 mg/kg and the fine-grained bedrock capacity was 0.006 to 0.009 mg/kg. It should be noted that these estimates represent the low end of the range for the site. Sorption could be higher for the following reasons:

- pH increased during the test from 6.0 to 8.2 in the trials in which sorption was observed, higher than the site at PZ-37, which yields pH less than 6.
- Concentrations of sulfate, a competing anion for sorption, are relatively high in YGWC-38 at 414 mg/L in October 2020 (when the bench-scale study samples were collected) and at 452 mg/L in the most recent sample collected in February 2022 from PZ-37. However, concentrations of sulfate have been declining at the R6 landfill monitoring wells since closure, allowing for stronger sorption of selenium with reduced competition from sulfate (Zachara et al 1994).

3.4 Selenium Conceptual Site Model

Elevated selenium concentrations are observed along the southeastern boundary of the R6 CCR Landfill. Additional borehole drilling and sampling and analysis of the deeper bedrock aquifer (BH-52, PZ-52D) further refined the vertical delineation of selenium impacts to shallower depths (approximately 90 ft) than previously determined by PZ-37D (approximately 200 ft).

Selenium concentrations in groundwater at the R6 Landfill are limited in extent, suggesting that CCR materials placed in some cells leached selenium while others did not or leached lesser amounts. Wells that exhibited elevated selenium concentrations (YGWC-41, YGWC-38, and PZ-37) have demonstrated decreases since closure of the R6 Landfill was completed in 2016. Elevated concentrations of selenium at YAMW-5 have been relatively stable and are expected to decrease following short-term perturbations in groundwater flow and geochemistry due to closure. Mechanisms accounting for the reduction in concentrations include sorption, dilution, and dispersion. Dilution and dispersion are demonstrated through the simultaneous concentration reductions in indicator constituents, such as boron and sulfate, as described in **Section 2.4**.

The attenuation mechanism of selenium sorption was evaluated and demonstrated through speciation analysis, general chemical analysis, mineralogical analysis, and sorption studies. The dominant species of selenium observed at YGWC-38, YGWC-41, and PZ-37 was selenate. Selenate forms outer sphere complexes with aluminum oxides, aluminosilicates, and there is evidence that selenate can form outer or inner sphere complexes on iron oxides, with inner sphere complexes forming at low pH (Peak and Sparks 2002). Under ambient groundwater conditions, the oxidized mineral phase hematite is the dominant species expected to participate in sorption reactions with selenium (**Figure 2.4**). Mineralogical analysis presented in Section 2.1 demonstrated the presence of aluminosilicates, i.e., kaolinite, by XRD. The presence of iron and aluminum that may be present in aluminum and iron oxides was demonstrated with bulk analysis and is further supported by the presence of iron-stained borehole materials as reported on borehole logs. General groundwater chemistry indicates favorable pH and redox conditions for sorption, with mildly acidic site groundwater favoring sorption of both selenite and selenate onto iron oxide species (Zachara et al. 1994, Peak and Sparks 2002). The presence of elevated sulfate associated with the CCR leachate at YGWC-38, YGWC-41, and PZ-37 inhibits the sorption of selenate through competitive sorption. Accordingly, as sulfate concentrations continue to decline over time, groundwater conditions are anticipated to become more favorable for the attenuation of selenium.

The attenuation of selenium in the saprolite and fine-grained bedrock material was directly demonstrated through the bench-scale study. The amount of sorption measured during the bench-scale study was low, relative to other contaminants.

The capacity of sorption as an attenuation mechanism was measured in the bench-scale study. Sorption coefficient (Kd) values of 0.12 liter per kilogram (L/Kg) to 0.25 L/Kg were calculated for saprolite and 0.1 to 0.16 L/kg for the fine-grained bedrock. Although the capacity was low, relative to other contaminants, it was conservatively estimated under oxidizing conditions with pH above the ambient values on the east side of the R6 CCR Landfill. The amount of selenium in groundwater upgradient of the monitoring wells with elevated selenium is limited. Following closure of the R6 CCR Landfill, the infiltration of selenium to groundwater was significantly reduced. Decreasing trends indicate that the sorption measured herein, coupled with dilution and dispersion, is sufficient to attenuate selenium in groundwater and continue the declining trends at the downgradient wells in the network.

Groundwater chemistry over time is the main determinant of whether selenium immobilized onto aquifer solids by natural attenuation processes will remain stable (Su et al., 2007). Immobilization of selenium through sorption at the site is currently favored by mildly acidic groundwater conditions (generally 5 to 7) and inhibited by the presence of elevated sulfate. Sulfate is a competing anion for sorption with selenate. Over time, groundwater conditions are anticipated to remain favorable for selenium sorption, promoting stability. The decreasing sulfate concentrations observed (**Section 2.4**) will favor the sorption of selenate over time, as the presence of that competing anion for sorption is reduced. The pH of upgradient water at the R6 CCR Landfill is mildly acidic and will continue to favor sorption of selenate after reaching GWPS.

4 References

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Tables

Table 2.1
Mineralogy Results
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfill

Sample ID (depth interval)	Lithology	Silicon	Aluminum	Iron	Potassium	Magnesium	Calcium	Titanium	Manganese	Barium	Chromium	Hydrogen	Oxygen	Sodium
YGWC-24SA (40-44)	Saprolite	36.6	7.41	1.50	1.22	0.62	0.45	0.08	0.05	0.04	-	-	-	-
YGWC-24SA (47-49)		34.5	7.82	1.98	1.54	1.06	0.45	0.10	0.09	0.04	-	-	-	-
YGWC-24SA (52-54)		36.6	NM	1.12	0.77	0.51	0.33	0.05	0.04	0.02	-	-	-	-
YGWC-38 (26-27)		37.8	6.33	1.06	0.64	0.43	0.34	0.05	0.02	0.02	-	-	-	-
YGWC-41 (32-33)	Partially Weathered Bedrock	36.3		1.52	0.82	0.58	0.67	0.08	0.05	0.02	-	-	-	-
YGWC-41 (48-49)		35.2	6.01	0.93	0.79	0.66	0.11	0.05	0.02	0.02	-	-	-	-
YAMW-3 (83-84)	Gneiss	36.7	5.98	0.90	0.87	0.53	0.36	0.05	0.02	-	0.02	-	-	-
NM = Not Measured														
YAMW-4 (88-89)		36.6	7.01	0.66	0.37	0.49	0.47	0.05	0.05	-	-	-	-	-
YGWC-38 (39-40)	Biotite Gneiss	37.0	6.66	0.93	0.98	0.43	0.4	0.04	0.02	0.02	-	-	-	-
YGWC-38 (59.5-60.5)		37.2	6.67	1.01	0.75	0.27	0.63	0.06	0.03	0.03	-	-	-	-
YGWC-41 (59-60)		37.1	6.55	0.93	0.65	0.63	0.34	0.06	0.02	0.02	-	-	-	-

Notes:
All values are as weight percent.
1. Values measured by chemical assay. Reported in weight percent.
- not detected

Table 2.2
Constituent Composition - Assay Results
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B' and R6 CRR Landfill

ARCADIS

Sample ID (depth interval)	Lithology	Silicon	Aluminum	Iron	Potassium	Magnesium	Calcium	Titanium	Manganese	Barium	Chromium	Hydrogen	Oxygen	Sodium
YGWC-24SA (40-44)	Saprolite	36.6	7.41	1.50	1.22	0.62	0.45	0.08	0.05	0.04	-	-	-	-
YGWC-24SA (47-49)		34.5	7.82	1.98	1.54	1.06	0.45	0.10	0.09	0.04	-	-	-	-
YGWC-24SA (52-54)		36.6	NM	1.12	0.77	0.51	0.33	0.05	0.04	0.02	-	-	-	-
YGWC-38 (26-27)		37.8	6.33	1.06	0.64	0.43	0.34	0.05	0.02	0.02	-	-	-	-
YGWC-41 (32-33)	Partially Weathered Bedrock	36.3		1.52	0.82	0.58	0.67	0.08	0.05	0.02	-	-	-	-
YGWC-41 (48-49)		35.2	6.01	0.93	0.79	0.66	0.11	0.05	0.02	0.02	-	-	-	-
YAMW-3 (83-84)	Gneiss	36.7	5.98	0.90	0.87	0.53	0.36	0.05	0.02	-	0.02	-	-	-
YAMW-4 (88-89)		36.6	7.01	0.66	0.37	0.49	0.47	0.05	0.05	-	-	-	-	-
YGWC-38 (39-40)	Biotite Gneiss	37.0	6.66	0.93	0.98	0.43	0.4	0.04	0.02	0.02	-	-	-	-
YGWC-38 (59.5-60.5)		37.2	6.67	1.01	0.75	0.27	0.63	0.06	0.03	0.03	-	-	-	-
YGWC-41 (59-60)		37.1	6.55	0.93	0.65	0.63	0.34	0.06	0.02	0.02	-	-	-	-

Notes:
All values are as weight percent.
1. Values measured by chemical assay. Reported in weight percent.
- not detected

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	PZ-35	PZ-35	PZ-35	PZ-35	PZ-35	PZ-35	PZ-35	PZ-35	PZ-35	PZ-37	PZ-37	PZ-37
			8/30/2018	10/16/2018	9/26/2019	3/25/2020	9/24/2020	2/10/2021	3/4/2021	9/1/2021	2/10/2022	10/12/2017	11/21/2017	1/11/2018
Appendix III	Boron	mg/L	**0.04**	**0.031 J**	< 0.04	**0.071 J**	**0.017 J**	NA	**0.012 J**	**0.044**	**0.054**	**15.4**	**17.2**	**15.8**
	Calcium	mg/L	NA	**6.5**	**4.83**	**7.9**	**3.6**	NA	**4.4**	**7.9**	**8.8**	**122**	**118**	**119**
	Chloride	mg/L	NA	**8.5**	**7.5**	**6.8**	**7.5**	NA	**6.7**	**6.3**	**5.6**	**5.4**	**6.5**	**5**
	Sulfate	mg/L	NA	**34.2**	**14.3**	NA	**7.2**	NA	**8.8**	**38.7**	**42.6**	**650**	**700**	**590**
	Total Dissolved Solids	mg/L	NA	**123**	NA	**84.0**	**100**	NA	**59.0**	**128**	**130**	**1060**	**1100**	**1020**
Appendix IV	Selenium	mg/L	NA	< 0.01	< 0.0025	< 0.0013	< 0.0016	< 0.0016	< 0.0016	**0.0016 J**	**0.003 J**	**0.234**	**0.225**	**0.168**
Field	Dissolved Oxygen	mg/L	NA	NA	NA	NA	4.8	5.21	5.57	4.14	4.02	0.25	0.29	0.14
	Iron (Ferrous)	mg/L	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	NA	NA	NA	NA	168.5	135.37	234.5	24.94	190.1	9.6	15.3	-32.5
	Eh [4]	mV	NA	NA	NA	NA	368.5	335.37	434.5	224.94	390.1	209.6	215.3	167.5
	pH	SU	NA	NA	NA	5.65	5.52	5.58	5.64	6.82	5.43	5.57	5.49	5.87
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	**13.5**	**28.5**	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	**13.5**	**28.5**	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	< 1	< 5.0	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	< 0.1	< 0.032	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	**2.57**	**4.6**	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	**0.0164**	**0.024 J**	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	**1.02 J**	**8.8**	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	**10.7**	**13.9**	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	PZ-37	PZ-37	PZ-37	PZ-37	PZ-37	PZ-37	PZ-37	PZ-37	PZ-37	PZ-37	PZ-37D	PZ-37D
			2/20/2018	4/3/2018	6/29/2018	8/6/2018	9/24/2018	9/25/2020	2/9/2021	3/4/2021	8/25/2021	2/10/2022	5/13/2021	9/3/2021
Appendix III	Boron	mg/L	19.5	17.5	20.6	15.9	16.5	14.1	NA	12.4	10.3	9.5	1.3	1.6
	Calcium	mg/L	124	114	129	114	115	108	NA	118	106	106	68.3	64.0
	Chloride	mg/L	5.2	4.8	5.7	4.8	4.9	4.3	NA	3.9	7.0	4.2	4.0	7.1
	Sulfate	mg/L	677	615	634	623	674	563	NA	485	472	452	178	153
	Total Dissolved Solids	mg/L	1050	1080	979	1020	1090	878	NA	856	876	798	381	374
Appendix IV	Selenium	mg/L	0.315	0.28	0.26	0.21	0.33	0.32	0.28	0.27	0.20	0.2	< 0.0016	< 0.0014
Field	Dissolved Oxygen	mg/L	0.37	0.22	0.31	0.22	0.42	0.3	0.88	0.73	0.77	2.86	NA	0.76
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	57.9	120.3	73.1	105.3	228.4	201.9	173.47	234.96	186.7	160.24	NA	-221.46
	Eh [4]	mV	257.9	320.3	273.1	305.3	428.4	401.9	373.47	434.96	386.7	360.24	NA	-21.46
	pH	SU	5.90	5.66	5.49	5.52	5.37	5.46	5.42	5.51	5.28	4.83	7.79	7.44
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	29	NA	NA	112
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	29	NA	NA	112
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	< 5	NA	NA	<5
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	53.1	NA	NA	12.6
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.6
	Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	34.6	NA	NA	27.7
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	PZ-37D	PZ-52D	PZ-52D	YAMW-3	YAMW-3	YAMW-3	YAMW-3	YAMW-3	YAMW-3	YAMW-4	YAMW-4	YAMW-4
			2/11/2022	11/4/2021	2/11/2022	1/16/2020	2/11/2020	9/3/2021	11/17/2021	12/9/2021	2/10/2022	1/16/2020	9/23/2020	2/9/2021
Appendix III	Boron	mg/L	**0.44**	**0.69**	**0.84**	**6.8**	**4.5**	NA	NA	NA	**7.7**	**1.9**	**2.5**	NA
	Calcium	mg/L	**49**	**25.6**	**27.3**	NA	NA	**42**	NA	NA	**29.4**	NA	**10.5**	NA
	Chloride	mg/L	**12.5**	**9.5**	**6.7**	NA	NA	NA	NA	NA	**3.2**	NA	**1.8**	NA
	Sulfate	mg/L	**115**	**191**	**209**	NA	NA	NA	NA	NA	**305**	NA	**152**	NA
	Total Dissolved Solids	mg/L	**382**	**426**	**456**	NA	NA	NA	NA	NA	**606**	NA	**329**	NA
Appendix IV	Selenium	mg/L	<0.0014	**0.0034 J**	**0.0025 J**	< 0.0013	NA	NA	NA	NA	<0.0014	**0.0018 J**	**0.016**	< 0.0016
Field	Dissolved Oxygen	mg/L	0.52	0.13	0.42	0.25	NA	6.41	NA	NA	0.45	0.31	1.2	9.25
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	-259.08	60.10	-128.94	-28.9	NA	194.73	NA	NA	-239.50	4.8	-142.4	44.68
	Eh [4]	mV	-59.08	260.1	71.06	171.1	NA	394.73	NA	NA	-39.5	204.8	57.6	244.68
	pH	SU	7.84	6.62	6.40	6.67	6.62	5.74	6.01	5.92	5.93	6.47	5.89	6.89
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	**66.1**	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	**66.1**	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	< 5	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	**74.1**	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	**18.5**	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	NA	**73.0**	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YAMW-4	YAMW-4	YAMW-4	YAMW-5	YAMW-5	YAMW-5	YAMW-5	YAMW-5	YAMW-5	YAMW-5	YGWA-39	YGWA-39
			3/3/2021	8/25/2021	2/10/2022	1/15/2020	2/11/2020	9/24/2020	2/9/2021	3/4/2021	8/26/2021	2/10/2022	10/11/2017	11/20/2017
Appendix III	Boron	mg/L	**0.81**	**2.8**	**3**	**8.7**	**7.8**	**8.7**	NA	**6.1**	**5.9**	**4.9**	**0.0135 J**	**0.0251 J**
	Calcium	mg/L	**20.6**	**11.0**	**11.6**	NA	NA	**61.3**	NA	**53.8**	**45.0**	**40.8**	**2.74**	**1.81**
	Chloride	mg/L	**22.9**	**1.5**	**1.4**	NA	NA	**3.7**	NA	**3.7**	**3.9**	**3.9**	**2.4**	**1.8**
	Sulfate	mg/L	**91.7**	**164**	**160**	NA	NA	**438**	NA	**340**	**338**	**276**	**20**	**24**
	Total Dissolved Solids	mg/L	**245**	**332**	**346**	NA	NA	**788**	NA	**604**	**570**	**499**	**68**	**139**
Appendix IV	Selenium	mg/L	< 0.0016	0.019	**0.019**	**0.045**	NA	**0.026**	**0.060**	**0.061**	**0.055**	**0.057**	< 0.01	< 0.01
Field	Dissolved Oxygen	mg/L	1.86	0.44	506.58	0.72	NA	1.8	10.52	5.65	2.02	2.21	0.2	2.69
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	-124.66	25.04	150.81	37	NA	219	223.76	266.64	260.96	89.09	184.4	74.9
	Eh [4]	mV	75.34	225.04	350.81	237	NA	419	423.76	466.64	460.96	289.09	384.4	274.9
	pH	SU	6.81	6.79	6.10	5.64	5.37	5.38	5.37	5.32	5.35	5.22	6.40	6.33
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	**61.4**	NA	NA	NA	NA	NA	NA	**13**	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	**61.4**	NA	NA	NA	NA	NA	NA	**13**	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	< 5	NA	NA	NA	NA	NA	NA	< 5	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	**36.1**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	**24.9**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Analyte		Units	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39
			1/11/2018	2/20/2018	4/3/2018	6/28/2018	8/7/2018	9/24/2018	3/27/2019	8/21/2019	10/8/2019	10/9/2019	2/12/2020	3/25/2020
Appendix III	Boron	mg/L	**0.0255 J**	< 0.04	**0.033 J**	**0.053**	**0.024 J**	**0.028 J**	**0.017 J**	NA	NA	**0.017 J**	NA	**0.043 J**
	Calcium	mg/L	**1.54**	**1.71**	**1.4**	**1.4**	**1.2**	**1.1**	**1.5**	NA	NA	**2.4**	NA	**2.7**
	Chloride	mg/L	**1.6**	**2**	**3.3**	**2.1**	**1.2**	**1.3**	**1.4**	NA	NA	**2.1**	NA	**1.9**
	Sulfate	mg/L	**23**	**20.6**	**24.5**	**22**	**20.7**	**21.2**	**17.7**	NA	NA	**15**	NA	NA
	Total Dissolved Solids	mg/L	**153**	**87**	**85**	**88**	**89**	**82**	**75**	NA	NA	**119**	NA	**158**
Appendix IV	Selenium	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	**0.0015 J**	NA	< 0.01	NA	< 0.01	< 0.0013	< 0.0013
Field	Dissolved Oxygen	mg/L	3.93	0.98	4.7	4.22	3.94	3.93	2.17	0.16	NA	0.1	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	-1.4	94.5	107.7	163.9	127.8	105.1	110.8	70.9	NA	56	NA	NA
	Eh [4]	mV	198.6	294.5	307.7	363.9	327.8	305.1	310.8	270.9	NA	256	NA	NA
	pH	SU	6.29	7.22	6.87	6.18	6.08	5.81	5.84	5.96	NA	5.81	5.97	5.78
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	**35**	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	**35**	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	**1.4**	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	**1.4**	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	**1.5**	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	**3**	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	**0.22**	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 0.2	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-39	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40
			9/24/2020	2/10/2021	3/4/2021	8/26/2021	2/8/2022	10/12/2017	11/20/2017	1/10/2018	2/19/2018	4/3/2018	6/28/2018	8/7/2018
Appendix III	Boron	mg/L	**0.037 J**	NA	**0.033 J**	**0.095**	**0.13**	**0.0401**	**0.156**	**0.15**	**0.146**	**0.12**	**0.16**	**0.12**
	Calcium	mg/L	**3.7**	NA	**8.2**	**14.1**	**15.2**	**2.9**	**10.4**	**10.2**	< 25	**6.3**	**6.7**	**6.3**
	Chloride	mg/L	**2.7**	NA	**4.9**	**7.2**	**7.4**	**3.8**	**4.4**	**4.6**	**4.6**	**5.9**	**5**	**4.3**
	Sulfate	mg/L	**11.7**	NA	**12.0**	**19.2**	**14.6**	**17**	**71**	**66**	**57.2**	**49.4**	**43.8**	**40.5**
	Total Dissolved Solids	mg/L	**170**	NA	**168**	**249**	**248**	**74**	**179**	**140**	**119**	**106**	**112**	**103**
Appendix IV	Selenium	mg/L	< 0.0016	< 0.0016	< 0.0016	< 0.0014	< 0.0014	< 0.01	**0.0042 J**	**0.0043 J**	< 0.01	< 0.01	**0.0032 J**	**0.0031 J**
Field	Dissolved Oxygen	mg/L	NA	0.13	1.05	0.16	0.19	3.85	5.77	5.85	5.55	5.31	5.6	5.23
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	NA	92.12	92.55	29.15	92	17.2	146.9	108.3	135.7	130	78.1	168.2
	Eh [4]	mV	NA	292.12	292.55	229.15	292	217.2	346.9	308.3	335.7	330	278.1	368.2
	pH	SU	5.70	5.80	5.54	6.91	5.78	5.43	5.10	4.97	5.60	5.84	5.24	5.18
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	19.1	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	6.60	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	29.6	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40	YGWA-40
			9/24/2018	3/26/2019	8/21/2019	10/8/2019	10/9/2019	2/12/2020	3/24/2020	9/24/2020	2/10/2021	3/4/2021	9/3/2021	2/8/2022
Appendix III	Boron	mg/L	**0.099**	**0.096**	NA	NA	**0.079**	NA	**0.088 J**	**0.087 J**	NA	**0.078**	**0.077**	**0.074**
	Calcium	mg/L	**5.7**	**5.6**	NA	NA	**5.2**	NA	**4.8**	**4.4**	NA	**4.6**	**5.6**	**6.0**
	Chloride	mg/L	**4.9**	**4.4**	NA	NA	**5.1**	NA	**4.7**	**5.0**	NA	**4.9**	**5.5**	**6.2**
	Sulfate	mg/L	**39.7**	**34.3**	NA	NA	**27.6**	NA	NA	**22.9**	NA	**21.5**	**21.3**	**17.9**
	Total Dissolved Solids	mg/L	**107**	**90**	NA	NA	**98**	NA	**84.0**	**77.0**	NA	**57.0**	**88.0**	**93**
Appendix IV	Selenium	mg/L	**0.0026 J**	NA	**0.0024 J**	NA	**0.0026 J**	**0.0020 J**	**0.0020 J**	**0.0016 J**	< 0.0016	< 0.0016	< 0.0014	**0.0014 J**
Field	Dissolved Oxygen	mg/L	5.64	5.21	5.14	NA	5.61	NA	NA	NA	6.14	3.89	0.68	0.53
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	145.8	187	102	NA	79.6	NA	NA	NA	121.99	226.63	229.69	211.7
	Eh [4]	mV	345.8	387	302	NA	279.6	NA	NA	NA	321.99	426.63	429.69	411.7
	pH	SU	5.14	5.30	5.26	NA	5.22	5.30	5.29	5.43	5.16	5.24	5.01	5.26
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	9.5	NA	NA	NA	NA	NA	**13.8**	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	9.5	NA	NA	NA	NA	NA	**13.8**	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	< 1	NA	NA	NA	NA	NA	< 5	NA
	Aluminum	mg/L	NA	NA	NA	NA	< 0.1	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	2.9	NA	NA	NA	NA	NA	**3.1**	NA
	Manganese	mg/L	NA	NA	NA	NA	< 0.04	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	2.0	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	7.9	NA	NA	NA	NA	NA	**9.1**	NA
	Sulfide	mg/L	NA	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S
			6/7/2016	7/28/2016	9/20/2016	11/8/2016	1/16/2017	3/9/2017	5/2/2017	7/10/2017	10/11/2017	3/30/2018	6/12/2018	9/27/2018
Appendix III	Boron	mg/L	**0.99**	**1.09**	**1.35**	**1.5**	**1.67**	**1.44**	**1.2**	**1.12**	**1.09**	NA	**0.9**	**0.71**
	Calcium	mg/L	**9.6**	**7.87**	**9.28**	**8.6**	**8.85**	**8.4**	**12.9**	**8.09**	**6.36**	NA	**4.7**	**4.1**
	Chloride	mg/L	**2.9**	**3.5**	**2.4**	**2.8**	**1.8**	**1.7**	**1.8**	**1.9**	**2.4**	NA	**1.8**	**2**
	Sulfate	mg/L	**56**	**57**	**68**	**79**	**72**	**69**	**60**	**57**	**52**	NA	**41.4**	**39.6**
	Total Dissolved Solids	mg/L	**130**	**119**	**132**	**146**	**194**	**288**	**221**	**123**	**100**	NA	**115**	**105**
Appendix IV	Selenium	mg/L	**0.037**	**0.0385**	**0.0464**	**0.0521**	**0.0469**	**0.0437**	**0.0395**	**0.0386**	NA	**0.028**	**0.026**	**0.023**
Field	Dissolved Oxygen	mg/L	5.87	6.17	6.84	7.02	7.52	7.91	8.15	7.65	NA	8.43	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	122.1	55.8	68.32	113.3	124.8	132.9	180.9	63.9	NA	91.8	NA	NA
	Eh [4]	mV	322.1	255.8	268.32	313.3	324.8	332.9	380.9	263.9	NA	291.8	NA	NA
	pH	SU	5.57	5.60	5.53	5.53	5.59	5.56	5.61	5.68	5.46	5.73	5.63	5.47
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-23S	YGWC-24S
			3/6/2019	4/4/2019	9/27/2019	10/10/2019	2/17/2020	3/26/2020	9/24/2020	2/9/2021	3/4/2021	8/25/2021	2/10/2022	6/8/2016
Appendix III	Boron	mg/L	NA	**0.6**	**0.58**	NA	NA	**0.94**	**1.1**	NA	**1.2**	**1.3**	**1.5**	< 0.05
	Calcium	mg/L	NA	**3.7**	**3.7**	**9.5**	NA	**5.6**	**7.9**	NA	**10.2**	**10.6**	**11.8**	**1.9**
	Chloride	mg/L	NA	**1.7**	**1.7**	**2**	NA	**1.6**	**2.0**	NA	**1.8**	**2.5**	**1.9**	**5.9**
	Sulfate	mg/L	NA	**27.9**	**30.3**	**29.5**	NA	NA	**52.5**	NA	**61.7**	**68.0**	**78.7**	< 1
	Total Dissolved Solids	mg/L	NA	**85**	**96**	NA	NA	**110**	**129**	NA	**96.0**	**141**	**180**	**66**
Appendix IV	Selenium	mg/L	**0.019**	**0.017**	**0.018**	NA	**0.020**	**0.024**	**0.031**	**0.032**	**0.037**	**0.032**	**0.039**	< 0.0013
Field	Dissolved Oxygen	mg/L	8.68	8.23	8.6	NA	NA	NA	NA	8.22	8.07	6.64	6.62	6.57
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	122.4	146.9	105.5	NA	NA	NA	NA	90.41	180.67	217.2	211.4	139.8
	Eh [4]	mV	322.4	346.9	305.5	NA	NA	NA	NA	290.41	380.67	417.2	411.4	339.8
	pH	SU	5.84	5.64	5.77	NA	5.84	5.69	5.51	5.73	5.47	5.46	5.51	5.65
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	**7**	NA	NA	NA	NA	NA	**13.9**	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	**7**	NA	NA	NA	NA	NA	**13.9**	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	< 1	NA	NA	NA	NA	NA	< 5	NA	NA
	Aluminum	mg/L	NA	NA	NA	**0.078 J**	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	**0.080**	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	**3.1**	NA	NA	NA	NA	NA	**9.0**	NA	NA
	Manganese	mg/L	NA	NA	NA	< 0.04	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	**0.72**	NA	NA	NA	NA	NA	**1.10**	NA	NA
	Sodium	mg/L	NA	NA	NA	**7**	NA	NA	NA	NA	NA	**13.5**	NA	NA
	Sulfide	mg/L	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-24S 8/1/2016	YGWC-24S 9/20/2016	YGWC-24S 11/8/2016	YGWC-24S 1/17/2017	YGWC-24S 3/8/2017	YGWC-24S 5/2/2017	YGWC-24S 7/7/2017	YGWC-24S 10/5/2017	YGWC-24S 3/30/2018	YGWC-24S 6/12/2018	YGWC-24S 9/26/2018	YGWC-24S 3/5/2019
Appendix III	Boron	mg/L	< 0.1 *	< 0.1 *	< 0.04 *	< 0.04 *	< 0.04	**0.0099 J**	**0.0076 J**	< 0.04	NA	**0.018 J**	**0.0055 J**	NA
	Calcium	mg/L	**1.83**	**1.78**	**1.77**	**1.7**	**1.77**	**1.57**	**1.8**	**1.7**	NA	**1.8**	**1.7**	NA
	Chloride	mg/L	**5.3**	**5.5**	**6.4**	**5.5**	**5.4**	**5.7**	**5.7**	**6**	NA	**6.2**	**6.9**	**NA**
	Sulfate	mg/L	**1.1**	**0.38 J**	**0.39 J**	< 1	**0.29 J**	**0.29 J**	**0.37 J**	< 1	NA	**0.35 J**	**0.28 J**	NA
	Total Dissolved Solids	mg/L	**56**	**53**	**58**	**56**	**192**	**113**	**46**	**48**	NA	**79**	**59**	NA
Appendix IV	Selenium	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	< 0.01	< 0.01	< 0.01
Field	Dissolved Oxygen	mg/L	5.65	6.19	5.44	5.79	5.86	6.01	6.33	NA	6.39	NA	NA	6.15
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	82.6	57.14	111.5	110	135.3	86.3	121.1	NA	127.5	NA	NA	116.6
	Eh [4]	mV	282.6	257.14	311.5	310	335.3	286.3	321.1	NA	327.5	NA	NA	316.6
	pH	SU	5.47	5.61	5.55	5.53	5.62	5.46	5.81	5.45	5.64	5.64	5.61	5.72
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-24S	YGWC-24S	YGWC-24S	YGWC-24S	YGWC-24S	YGWC-24S	YGWC-24SA	YGWC-24SA	YGWC-24SA	YGWC-24SA	YGWC-24SA	YGWC-36
			4/4/2019	4/9/2019	9/26/2019	10/10/2019	2/13/2020	3/26/2020	9/23/2020	2/9/2021	3/3/2021	9/1/2021	2/10/2022	9/2/2016
Appendix III	Boron	mg/L	< 0.04	NA	**0.0068 J**	NA	NA	**0.033 J**	< 0.0052	NA	< 0.0052	< 0.0086	<0.0086	**0.133**
	Calcium	mg/L	**1.9**	NA	**1.7**	**1.7**	NA	**1.7**	**2.4**	NA	**2.4**	**2.3**	**2.2**	**11.2**
	Chloride	mg/L	**5.9**	NA	**6.5**	**6.8**	NA	**5.4**	**9.3**	NA	**8.6**	**8.9**	**8.7**	**6.3**
	Sulfate	mg/L	**0.29 J**	NA	**0.23 J**	**0.21 J**	NA	NA	< 0.50	NA	< 0.50	< 0.50	<0.50	**72**
	Total Dissolved Solids	mg/L	**63**	NA	**81**	NA	NA	**67.0**	**87**	NA	**70.0**	**96.0**	**78**	**243**
Appendix IV	Selenium	mg/L	< 0.01	NA	< 0.01	NA	< 0.0013	< 0.0013	< 0.0016	< 0.0016	< 0.0016	< 0.0014	<0.0014	**0.0012 J**
Field	Dissolved Oxygen	mg/L	6.37	NA	6.13	NA	NA	NA	NA	8.12	6.59	6.34	6.73	1.98
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	192.6	NA	142.7	NA	NA	NA	NA	205.13	258.58	169.69	234.14	51.5
	Eh [4]	mV	392.6	NA	342.7	NA	NA	NA	NA	405.13	458.58	369.69	434.14	251.5
	pH	SU	5.66	NA	5.52	NA	5.69	5.51	5.64	5.69	5.70	5.22	4.66	5.84
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	**13**	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	**13**	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	< 1	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	< 0.1	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	**1.3**	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	< 0.04	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	**0.61**	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	**7.9**	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Analyte		Units	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36
			9/22/2016	9/29/2016	10/6/2016	11/14/2016	2/28/2017	5/9/2017	7/13/2017	9/22/2017	9/29/2017	10/6/2017	10/11/2017	3/30/2018
Appendix III	Boron	mg/L	NA	NA	NA	**0.287**	**0.215**	**0.233**	**0.262**	**0.238**	**0.235**	**0.256**	**0.245**	NA
	Calcium	mg/L	NA	NA	NA	**7.79**	**8.37**	**13.9**	**16.6**	**18.4**	**16.1**	**16.6**	**18.1**	NA
	Chloride	mg/L	NA	NA	NA	**6.7**	**5.4**	**5.7**	**5.4**	**6.9**	**5.5**	**5.5**	**6.4**	NA
	Sulfate	mg/L	NA	NA	NA	**110**	**110**	**130**	**140**	**160**	**160**	**160**	**150**	NA
	Total Dissolved Solids	mg/L	NA	NA	NA	**272**	**306**	**303**	**282**	**309**	**273**	**287**	**264**	NA
Appendix IV	Selenium	mg/L	NA	NA	NA	< 0.05	**0.0017 J**	**0.0018 J**	**0.0031 J**	**0.0024 J**	**0.002 J**	< 0.01	NA	< 0.01
Field	Dissolved Oxygen	mg/L	NA	NA	NA	0.24	NA	NA	NA	NA	NA	NA	NA	0.87
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	NA	NA	NA	60.9	NA	NA	NA	NA	NA	NA	NA	139.5
	Eh [4]	mV	NA	NA	NA	260.9	NA	NA	NA	NA	NA	NA	NA	339.5
	pH	SU	NA	NA	NA	6.28	5.99	6.30	5.57	5.50	5.58	5.51	5.47	5.51
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36	YGWC-36A	YGWC-36A	YGWC-36A	YGWC-36A
			6/13/2018	9/26/2018	3/6/2019	4/4/2019	9/26/2019	10/10/2019	2/14/2020	3/25/2020	10/7/2020	2/10/2021	3/4/2021	9/3/2021
Appendix III	Boron	mg/L	**0.25**	**0.24**	NA	**0.22**	**0.13**	NA	NA	**0.11**	**0.018 J**	NA	**0.0088 J**	**0.012 J**
	Calcium	mg/L	**18.7 J**	**19.8 J**	NA	**16.9 J**	**11.7**	12.2	NA	**10.6**	**9.9**	NA	**5.6**	**4.1**
	Chloride	mg/L	**5.6**	**6**	NA	**5.4**	**7.1**	NA	NA	**6.6**	**8.7**	NA	**6.6**	**7.0**
	Sulfate	mg/L	**144**	**160**	NA	**119**	**84.8**	NA	NA	NA	**18.2**	NA	**6.3**	**13.8**
	Total Dissolved Solids	mg/L	**292**	**277**	NA	**240**	**198**	NA	NA	**164**	**137**	NA	**69.0**	**89.0**
Appendix IV	Selenium	mg/L	**0.0024 J**	**0.0037 J**	**0.0033 J**	**0.0029 J**	**0.0019 J**	NA	**0.0020 J**	**0.0024 J**	< 0.0016	< 0.0016	< 0.0016	< 0.0014
Field	Dissolved Oxygen	mg/L	NA	NA	1.94	1.47	0.78	NA	NA	NA	NA	8.5	4.43	4.52
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	0 (NA)	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	NA	NA	125.3	164.3	138.3	NA	NA	NA	NA	121.6	217.8	107.99
	Eh [4]	mV	NA	NA	325.3	364.3	338.3	NA	NA	NA	NA	321.6	417.8	307.99
	pH	SU	5.50	5.53	5.21	5.74	5.51	NA	5.71	5.49	5.86	6.31	5.73	5.06
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	**12**	NA	**10.9**	NA	NA	NA	**10.9**
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	**12**	NA	**10.9**	NA	NA	NA	**10.9**
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	< 1	NA	< 5.0	NA	NA	NA	< 5
	Aluminum	mg/L	NA	NA	NA	NA	NA	< 0.1	NA	< 0.032	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	0.028 J	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	**7.4**	NA	**6.1**	NA	NA	NA	**1.6**
	Manganese	mg/L	NA	NA	NA	NA	NA	**0.062**	NA	**0.036 J**	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	**1.9**	NA	**1.9**	NA	NA	NA	**0.79**
	Sodium	mg/L	NA	NA	NA	NA	NA	**18.2**	NA	**18**	NA	NA	NA	**11.2**
	Sulfide	mg/L	NA	NA	NA	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-36A	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38
			2/11/2022	10/12/2017	11/20/2017	1/12/2018	2/20/2018	4/3/2018	6/28/2018	8/7/2018	9/24/2018	3/27/2019	8/22/2019	10/8/2019
Appendix III	Boron	mg/L	**0.019 J**	**19.3**	**21.8**	**18.7**	**18.6**	**20.9**	**22.7**	**19.1**	**18.4**	**16.7**	NA	NA
	Calcium	mg/L	**4.6**	**190**	**184**	**178**	**184**	**174**	**190**	**176**	**172**	**155**	NA	NA
	Chloride	mg/L	**6.6**	**6**	**6.9**	**6.6**	**6.2**	**6.9**	**6.4**	**5.5**	**5.9**	**6.2**	NA	NA
	Sulfate	mg/L	**16.4**	**940**	**980**	**880**	**905**	**872**	**869**	**879**	**872**	**851**	NA	NA
	Total Dissolved Solids	mg/L	**81**	**1360**	**1390**	**1400**	**1300**	**1390**	**1310**	**1340**	**1400**	**1190**	NA	NA
Appendix IV	Selenium	mg/L	<0.0014	**0.265**	**0.246**	**0.249**	**0.253**	**0.23**	**0.23**	**0.2**	**0.2**	NA	**0.14**	NA
Field	Dissolved Oxygen	mg/L	4.29	0.36	2.76	0.44	1.58	0.88	0.54	0.44	0.85	1.47	1.76	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	183.42	172.8	181.3	107.5	85.2	161.5	99.2	209.9	184.6	162.4	118.4	NA
	Eh [4]	mV	383.42	372.8	381.3	307.5	285.2	361.5	299.2	409.9	384.6	362.4	318.4	NA
	pH	SU	5.58	4.85	4.87	4.78	5.10	4.76	4.75	4.72	4.67	4.79	4.81	NA
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-38	YGWC-41	YGWC-41	YGWC-41	YGWC-41
			10/9/2019	2/14/2020	3/25/2020	9/25/2020	2/9/2021	3/4/2021	8/26/2021	2/10/2022	10/12/2017	11/21/2017	1/11/2018	2/19/2018
Appendix III	Boron	mg/L	**13.5**	NA	**9.3**	**8.0**	NA	**6.4**	**6.1**	**5.4**	**12**	**12.1**	**12.8**	**15.2**
	Calcium	mg/L	**147**	NA	**124**	**93.7**	NA	**87.0**	**73.6**	**68.9**	**44.5**	**44.4**	**43.9**	**45.3**
	Chloride	mg/L	**4.8**	NA	**4.0**	**4.0**	NA	**3.9**	**4.1**	**4**	**3.1**	**4.2**	**3.8**	**3.5**
	Sulfate	mg/L	**692**	NA	NA	**414**	NA	**356**	**328**	**290**	**400**	**430**	**390**	**414**
	Total Dissolved Solids	mg/L	**1100**	NA	**883**	**664**	NA	**600**	**562**	**541**	**636**	**706**	**701**	**630**
Appendix IV	Selenium	mg/L	**0.12**	**0.11**	**0.099**	**0.076**	**0.073**	**0.076**	**0.060**	**0.064**	**0.0191**	**0.0687**	**0.069**	**0.071**
Field	Dissolved Oxygen	mg/L	2.09	NA	NA	NA	4.23	3.96	3.83	3.53	0.19	1.1	1.2	1.17
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	101.8	NA	NA	NA	144.02	233.18	267.7	169.91	49	105.8	73.7	130.9
	Eh [4]	mV	301.8	NA	NA	NA	344.02	433.18	467.7	369.91	249	305.8	273.7	330.9
	pH	SU	4.80	4.84	4.89	4.90	5.04	5.01	4.54	4.85	4.94	4.69	4.73	4.96
Supplemental	Alkalinity (as CaCO3)	mg/L	**8.5**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	**8.5**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	< 20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	**0.068 J**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	**73.2**	NA	NA	NA	NA	NA	**36.8**	NA	NA	NA	NA	NA
	Manganese	mg/L	**0.11**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	**6.1**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	**24.3**	NA	NA	NA	NA	NA	**20.8**	NA	NA	NA	NA	NA
	Sulfide	mg/L	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-41	YGWC-41	YGWC-41	YGWC-41	YGWC-41	YGWC-41	YGWC-41	YGWC-41	YGWC-41	YGWC-41	YGWC-41	YGWC-41
			4/3/2018	6/27/2018	8/7/2018	9/24/2018	3/28/2019	8/22/2019	10/8/2019	10/9/2019	2/14/2020	3/25/2020	9/25/2020	2/10/2021
Appendix III	Boron	mg/L	**14.5**	**14.1**	**11.9**	**12.2**	**7.1**	NA	NA	**8.6**	NA	**7.9**	**6.0**	NA
	Calcium	mg/L	**42.7**	**42.2**	**40.7**	**38.5**	**26**	NA	NA	**30.9**	NA	**29.6**	**20.5**	NA
	Chloride	mg/L	**4.4**	**3.6**	**3.3**	**3.3**	**3.2**	NA	NA	**3.3**	NA	**2.7**	**3.0**	NA
	Sulfate	mg/L	**406**	**357**	**346**	**358**	**258**	NA	NA	**256**	NA	NA	**175**	NA
	Total Dissolved Solids	mg/L	**660**	**575**	**574**	**588**	**372**	NA	NA	**440**	NA	**428**	**307**	NA
Appendix IV	Selenium	mg/L	**0.067**	**0.066**	**0.061**	**0.061**	NA	**0.058**	NA	**0.052**	**0.059**	**0.057**	**0.046**	**0.033**
Field	Dissolved Oxygen	mg/L	3.79	1.53	1.84	1.93	2.71	2.56	NA	4.94	NA	NA	NA	5.72
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	156.5	64.7	176.7	746.6	202.4	110.7	NA	92.7	NA	NA	NA	125.48
	Eh [4]	mV	356.5	264.7	376.7	946.6	402.4	310.7	NA	292.7	NA	NA	NA	325.48
	pH	SU	5.31	4.78	4.77	4.78	5.00	4.89	NA	4.86	4.84	4.87	4.95	5.25
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	**4.5**	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	**4.5**	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	**0.048 J**	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	< 0.2	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	< 0.2	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	**0.3**	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	**36.4**	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	**0.073**	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	**3.5**	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	**20.5**	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	< 0.2	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-41	YGWC-41	YGWC-41	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42
			3/4/2021	8/26/2021	2/8/2022	8/30/2016	11/16/2016	2/27/2017	5/10/2017	7/11/2017	10/12/2017	4/4/2018	9/20/2018	3/27/2019
Appendix III	Boron	mg/L	**4.0**	**3.3**	**4.0**	**24.7**	**16.4**	**17.9**	**20.4**	**25.2**	**20**	**22.7**	**20.3**	**20.3**
	Calcium	mg/L	**16.4**	**12.8**	**15.0**	**133**	**125**	**139**	**130**	**172**	**144**	**137**	**108**	**109**
	Chloride	mg/L	**3.4**	**3.6**	**3.5**	**4.4**	**4.7**	**4.7**	**4.4**	**4.7**	**4.3**	**3.7**	**3.8**	**3.9**
	Sulfate	mg/L	**117**	**117**	**109**	**980**	**940**	**940**	**1200**	**1300**	**1100**	**1020**	**810**	**831**
	Total Dissolved Solids	mg/L	**224**	**225**	**226**	**1650**	**1420**	**1640**	**1630**	**1800**	**1600**	**1520**	**1240**	**1100**
Appendix IV	Selenium	mg/L	**0.037**	**0.027**	**0.031**	**0.0711**	**0.0313**	**0.0316**	**0.053**	**0.0697**	**0.0594**	**0.055**	**0.041**	NA
Field	Dissolved Oxygen	mg/L	4.53	4.06	5.48	NA	0.33	0.49	0.49	0.6	0.64	0.69	0.56	0.7
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	237.7	40.79	270.9	NA	-13.8	59.3	57	43	118.9	112.33	83.9	121.1
	Eh [4]	mV	437.7	240.79	470.9	NA	186.2	259.3	257	243	318.9	312.33	283.9	321.1
	pH	SU	4.68	6.77	5.07	5.64	6.21	6.09	5.79	5.45	5.48	5.93	5.63	5.57
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	< 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	< 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	< 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Magnesium	mg/L	NA	**16.5**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	**13.5**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

ARCADIS

Analyte		Units	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-42	YGWC-43	YGWC-43
			8/22/2019	10/8/2019	10/9/2019	2/14/2020	3/25/2020	9/24/2020	2/10/2021	3/4/2021	8/25/2021	2/10/2022	8/31/2016	11/16/2016
Appendix III	Boron	mg/L	NA	NA	**16.6**	NA	**15.5**	**15.2**	NA	**14.8**	**13.5**	**14.4**	**0.169**	**0.406**
	Calcium	mg/L	NA	NA	**103**	NA	**107**	**84.3**	NA	**90.7**	**79.9**	**74.4**	**3.4**	**3.79**
	Chloride	mg/L	NA	NA	**4.3**	NA	**3.2**	**3.3**	NA	**2.7**	**3.4**	**3.3**	**1.5**	**1.7**
	Sulfate	mg/L	NA	NA	**732**	NA	NA	**579**	NA	**537**	**500**	**485**	**34**	**240**
	Total Dissolved Solids	mg/L	NA	NA	**1170**	NA	**1200**	**1060**	NA	**501**	**886**	**882**	**80**	**112**
Appendix IV	Selenium	mg/L	**0.047**	NA	**0.042**	**0.040**	**0.046**	**0.046**	**0.043**	**0.048**	**0.043**	**0.044**	< 0.01	< 0.01
Field	Dissolved Oxygen	mg/L	0.86	NA	1.44	NA	NA	NA	5.11	1.88	1.33	1.78	NA	0.12
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	114.2	NA	113.9	NA	NA	NA	157.84	227.39	28.2	188.9	NA	-76.6
	Eh [4]	mV	314.2	NA	313.9	NA	NA	NA	357.84	427.39	228.2	388.9	NA	123.4
	pH	SU	5.61	NA	5.50	5.80	5.53	5.55	5.55	5.59	6.73	5.57	7.27	6.79
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	**36**	NA	NA	NA	NA	NA	**38.5**	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	**36**	NA	NA	NA	NA	NA	**38.5**	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	< 20	NA	NA	NA	NA	NA	< 5	NA	NA	NA
	Aluminum	mg/L	NA	NA	**0.047 J**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	mg/L	NA	NA	**0.35**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	**0.35**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	0	NA	NA	NA	NA	NA	**11.5**	NA	NA	NA
	Magnesium	mg/L	NA	NA	**110**	NA	NA	NA	NA	NA	**80.9**	NA	NA	NA
	Manganese	mg/L	NA	NA	**0.12**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	**11.7**	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	**28.8**	NA	NA	NA	NA	NA	**36.4**	NA	NA	NA
	Sulfide	mg/L	NA	NA	< 0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-43	YGWC-43	YGWC-43	YGWC-43	YGWC-43	YGWC-43	YGWC-43	YGWC-43	YGWC-43	YGWC-43	YGWC-43	YGWC-43
			2/24/2017	5/10/2017	7/11/2017	10/12/2017	4/4/2018	9/20/2018	3/28/2019	8/21/2019	10/9/2019	2/17/2020	3/25/2020	9/25/2020
Appendix III	Boron	mg/L	**0.725**	**0.955**	**0.994**	**1.15**	**1.2**	**2.1**	**1.8**	NA	**2.7**	NA	**2.4**	**3.9**
	Calcium	mg/L	**6.42**	**7.9**	**6.71**	**7.05**	**8.6**	**15.9 J**	**8.9**	NA	**21.9**	NA	**12.1**	**19.8**
	Chloride	mg/L	**1.5**	**1.2**	**1.5**	**1.6**	**1.8**	**1.9**	**1.8**	NA	**2.4**	NA	**1.8**	**2.3**
	Sulfate	mg/L	**89**	**100**	**110**	**120**	**160**	**247**	**181**	NA	**279**	NA	NA	**281**
	Total Dissolved Solids	mg/L	**147**	**203**	**238**	**287**	**292**	**434**	**323**	NA	**501**	NA	**352**	**494**
Appendix IV	Selenium	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	< 0.01	< 0.0013	< 0.0013	< 0.0016
Field	Dissolved Oxygen	mg/L	0.13	0.12	0.12	0.08	0.09	0.1	0.06	0.08	0.06	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	-25.4	-13.8	-71.5	41.7	77.1	-1	71.8	36	44.9	NA	NA	NA
	Eh [4]	mV	174.6	186.2	128.5	241.7	277.1	199	271.8	236	244.9	NA	NA	NA
	pH	SU	6.39	6.50	6.32	5.97	6.41	5.69	5.96	5.84	5.78	5.93	5.79	5.75
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**42**	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**42**	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	< 20	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	< 0.1	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**26**	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**26**	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**3**	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**43**	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**1.7**	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**8.1**	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	**20.7**	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	< 0.2	NA	NA	NA

Notes are provided on last page.

Table 2.3
Groundwater Analytical Data (2016 - 2022)
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfil

Analyte		Units	YGWC-43	YGWC-43	YGWC-43	YGWC-43
			2/9/2021	3/4/2021	9/27/2021	2/8/2022
Appendix III	Boron	mg/L	NA	**3.6**	**0.64**	**2.3**
	Calcium	mg/L	NA	**32.2**	**4.1**	**9.9**
	Chloride	mg/L	NA	**2.1**	**1.1**	**2.1**
	Sulfate	mg/L	NA	**328**	**56.5**	**133**
	Total Dissolved Solids	mg/L	NA	**592**	**158**	**294**
Appendix IV	Selenium	mg/L	< 0.0016	< 0.0016	<0.0014	<0.0014
Field	Dissolved Oxygen	mg/L	5.57	8.69	0.25	0.13
	Iron (Ferrous)	mg/L	NA	NA	NA	NA
	Oxidation Reduction Potential	mV	43.08	-19.08	-13	-99.81
	Eh [4]	mV	243.08	180.92	187	100.19
	pH	SU	5.82	5.88	6.08	5.82
Supplemental	Alkalinity (as CaCO3)	mg/L	NA	NA	NA	NA
	Alkalinity, Bicarbonate	mg/L	NA	NA	NA	NA
	Alkalinity, Carbonate	mg/L	NA	NA	NA	NA
	Aluminum	mg/L	NA	NA	NA	NA
	Iron	mg/L	NA	NA	NA	NA
	Iron (Ferric)	mg/L	NA	NA	NA	NA
	Iron (Ferrous)	mg/L	NA	NA	NA	NA
	Magnesium	mg/L	NA	NA	NA	NA
	Manganese	mg/L	NA	NA	NA	NA
	Potassium	mg/L	NA	NA	NA	NA
	Sodium	mg/L	NA	NA	NA	NA
	Sulfide	mg/L	NA	NA	NA	NA

Notes are provided on last page.

Notes:
1. < indicates the analyte was not detected above the laboratory method detection limit (MDL).
2. J values indicate the substance was detected at such low levels that the precision of the laboratory instrument could not produce a reliable value.
Therefore, the value displayed (value J) is qualified by the laboratory as an estimated value.
3. Detections are in **bold**
4. Eh is calculated from the field ORP value and corrected for the silver-silver chloride electrode (Ag/AgCl)
mg/L - milligrams per liter
S.U. - Standard Units
CaCO3 - Calcium carbonate
mV - millivolts
Eh is calculated from the field ORP value and corrected for the silver-silver chloride electrode (Ag/AgCl)
NA - Not Analyzed

Table 3.1
Selenium Speciation Results
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfill

Sample ID	Sample Date	MeSe(IV)	Se	Se(IV)	Se(VI)	SeCN	SeMet	$SeSO_3$
YGWC-38	9/25/2020	<0.350 U	85.9	<0.350 U	82.10	<0.250 U	<0.350 U	<0.300 U
YGWC-41	9/25/2020	<0.350 U	50.7	<0.350 U	49.30	<0.250 U	<0.350 U	<0.300 U
PZ-37	4/7/2022	<2.00	NM	4.79	188	<2.00	<2.00	<2.00

Notes:
Samples were field filtered (0.45 micron), shipped at 0-4 degrees C, and cyrofrozen in laboratory at -80 degrees C per laboratory guidance
All results are dissolved fraction
All results are in micrograms per liter (µg/L)
NM = Not Measured
Me Se (IV) = methylseleninic acid
Se = selenium
Se(IV) = selenite
Se(VI) = selenate
SeCN = selenocyanate
SeMet = selenomethionine
$SeSO_3$ = selenium sulfite
U = Result is less than or equal to the method detection limit (MDL)

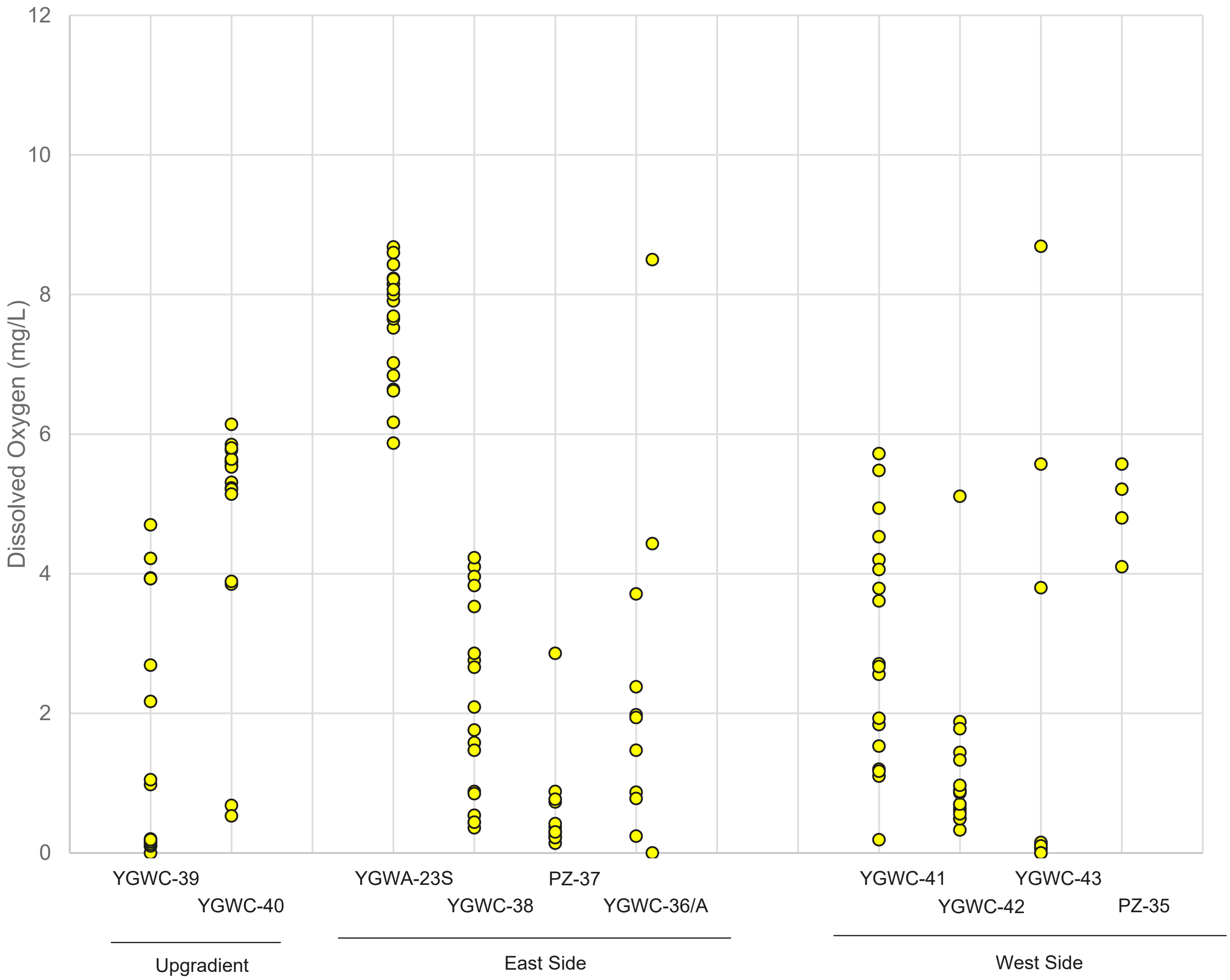
Table 3.2
Sorption Study Details and Results
Geochemical Conceptual Site Model Report
Plant Yates; Ash Ponds 3, A, B, and B'; and R6 CRR Landfill

Initial Conditions						Results			
Lithology	Mass Solids (g)	Volume Groundwater (mL)	pH	Selenium Concentration Control (mg/L)	Mass Selenium Added per Mass Aquifer Solids (mg/kg)	Selenium Concentration Aqueous (mg/L)	Percent Removed	Sorption Coefficient, Kd (L/kg)	Mass Selenium Adsorbed per Mass Aquifer Material (mg/kg)
Saprolite	0.24	259	NM	0.075	81	0.075	0	N/A	N/A
	5.0	395	4.5	0.075	5.9	0.082	0	N/A	N/A
	50	370	NM	0.075	0.56	0.082	0	N/A	N/A
	250	260	6.4	0.075	0.08	0.067	11	0.12	0.008
	350	175	NM	0.075	0.04	0.050	33	0.25	0.013
	300	100	NM	0.075	0.03	0.043	43	0.25	0.011
Biotite-Gneiss (Fine - Grained)	2.4	250	6.0	0.075	7.9	0.071	Nominal	N/A	N/A
	50	370	6.3	0.075	0.6	0.078	0	N/A	N/A
	200	290	7.6	0.075	0.11	0.070	7	0.10	0.007
	500	120	8.2	0.075	0.02	0.052	31	0.11	0.006
	800	350	NM	0.075	0.03	0.055	27	0.16	0.009
Biotite-Gneiss (Coarse -Grained)	2.4	250	5.9	0.075	N/A	0.076	0	N/A	N/A
	50	370	5.4	0.075	N/A	0.081	0	N/A	N/A
	200	290	7.1	0.075	N/A	0.079	0	N/A	N/A
	500	120	8.4	0.075	N/A	0.076	0	N/A	N/A
	800	350	7.5	0.075	N/A	0.073	0	N/A	N/A

Notes:
g = gram
mL = milliliter
Kd = sorption coefficient
L/kg = liter per kilogram
mg/L = milligram per liter
mg/kg = milligram per kilogram
N/A = Not Applicable
NM = Not measured

Samples were transported to the laboratory and analyzed under atmospheric conditions.

Figures



Notes:
2016 through 2022 result values shown
mg/L – milligrams per liter
– sample result

Georgia Power

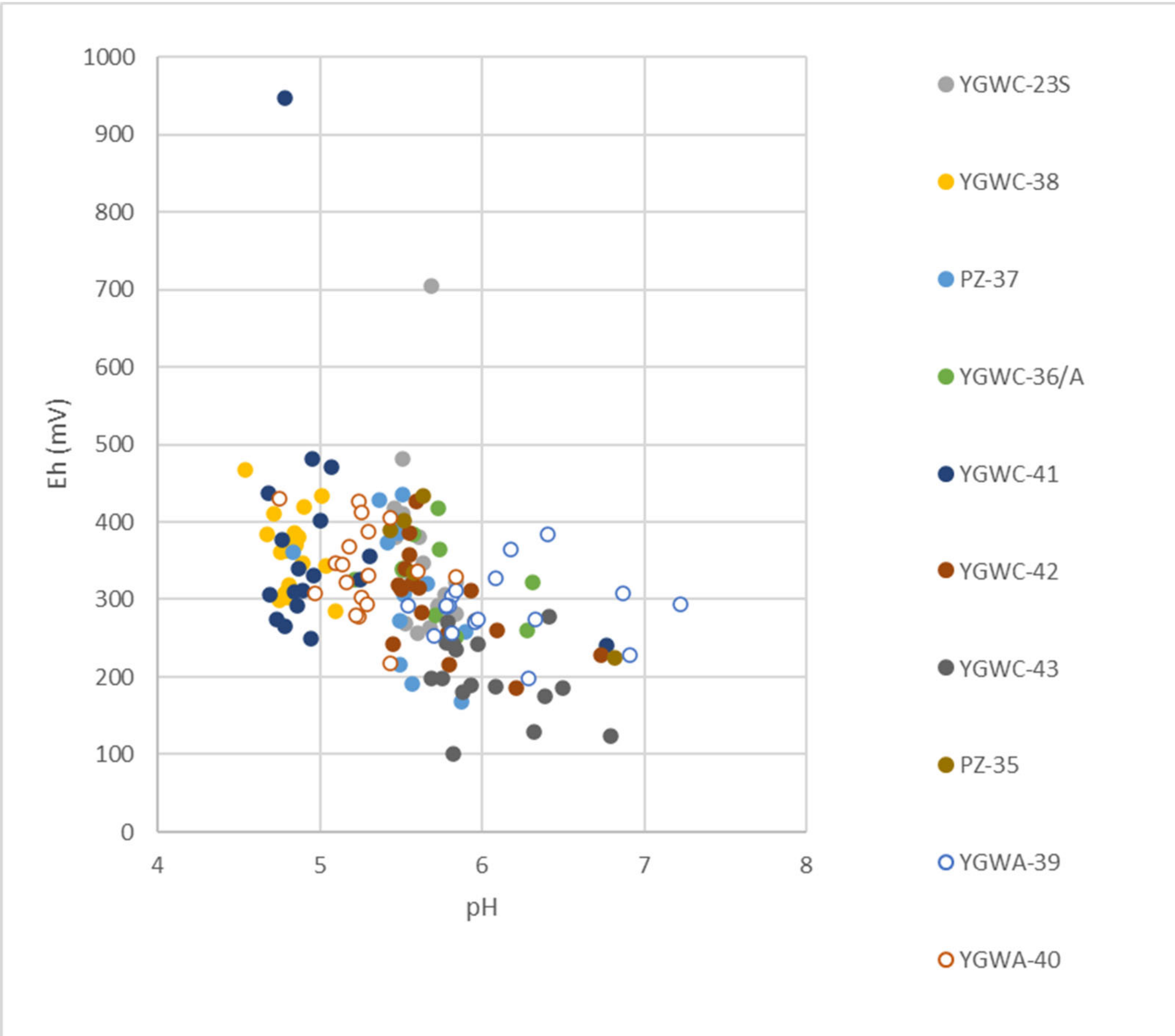
PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

DISSOLVED OXYGEN CONCENTRATION SUMMARY

ARCADIS

FIGURE
2.1

4/15/2022 8:20:58 AM



Notes:
2016 through 2022 result values shown
mV - millivolts

Georgia Power

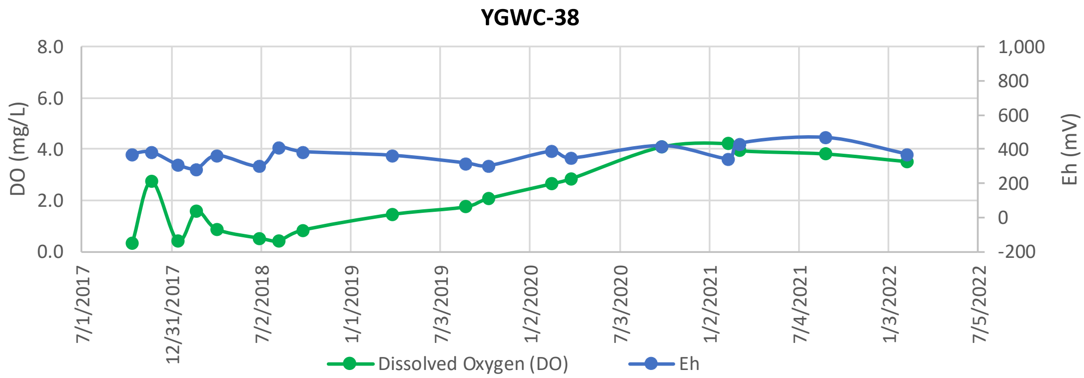
PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

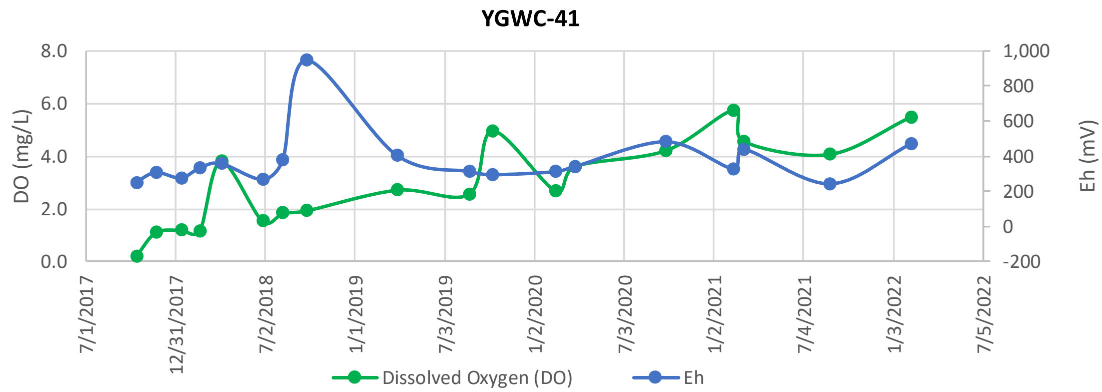
EH PH DATA SUMMARY

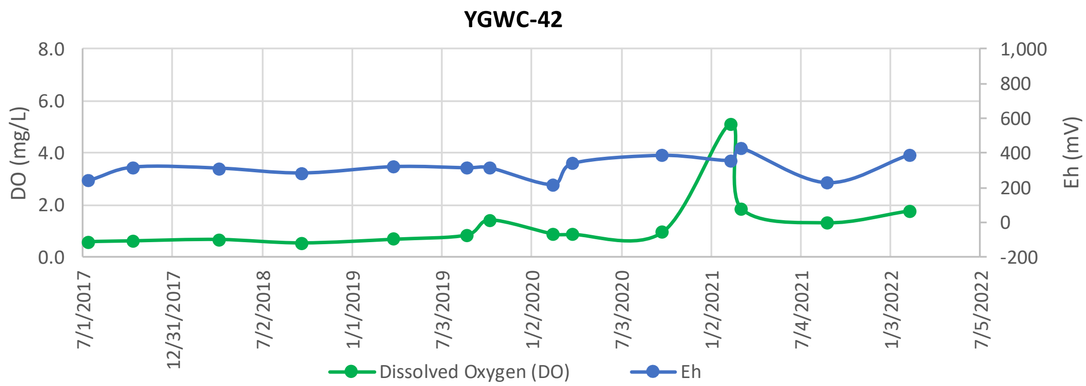
ARCADIS

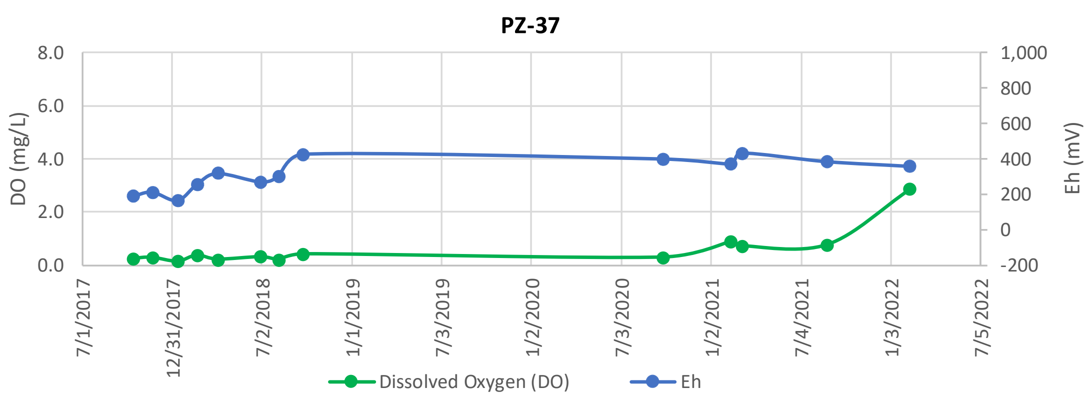
FIGURE
2.2

4/15/2022 8:20:01 AM









Notes:
R6 CCR Landfill closure complete in 2016
mg/L – milligrams per liter
mV – millivolts

Georgia Power

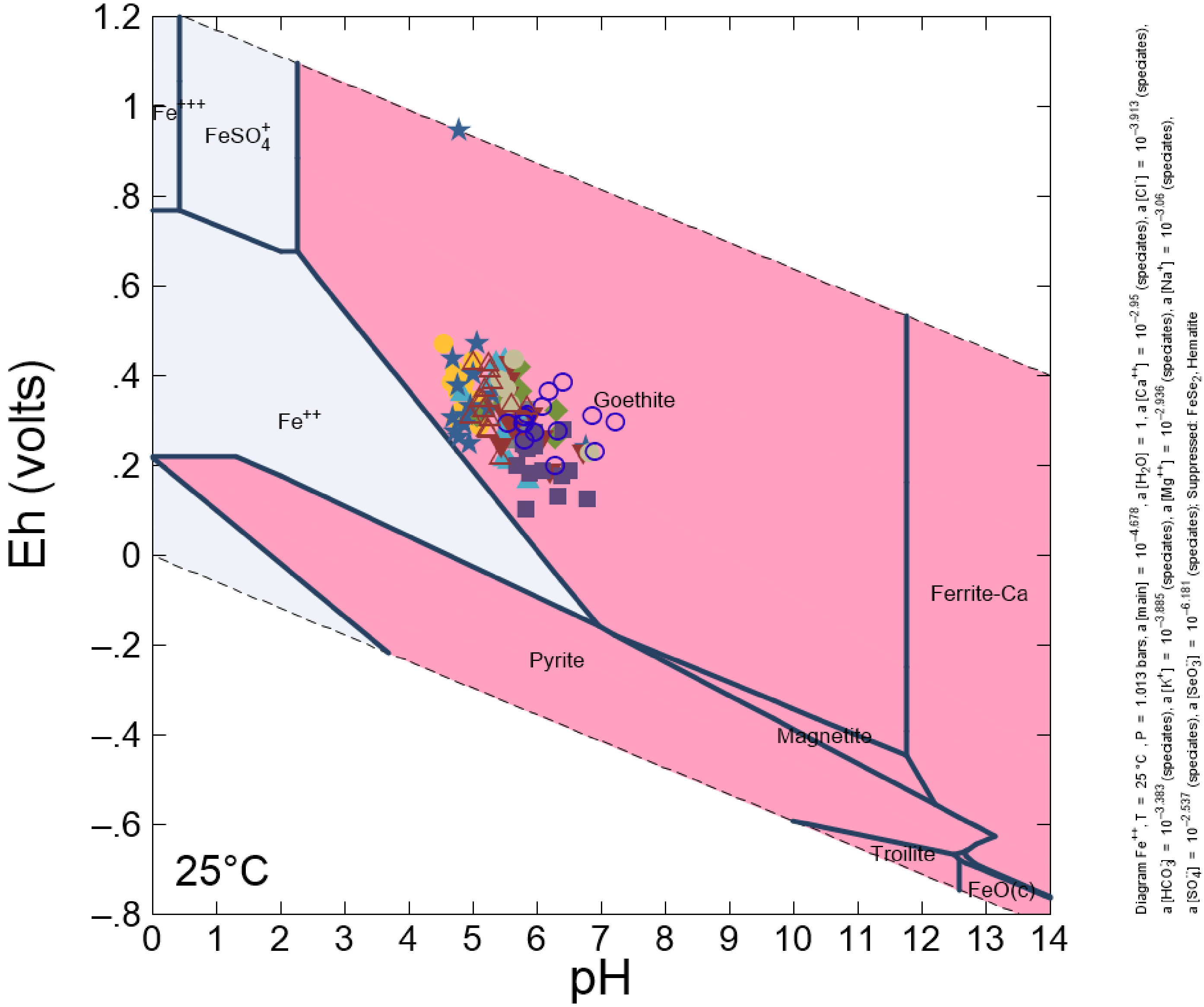
PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

DISSOLVED OXYGEN CONCENTRATION AND EH TRENDS

ARCADIS

FIGURE
2.3

8/4/2022 8:29:20 AM



Notes:

1. This Eh-pH diagram was produced with Geochemist's Workbench. The LLNL thermodynamic database, "thermo.tdat", the program's default database, was used.
2. The basis species in the LLNL thermodynamic database for ferrous iron (Fe^{2+}) was used to construct the Eh-pH diagram. A representative value of all wells included in this figure (2.09925e-05 mol/L) was used. Units needed to create Eh-pH diagram is activity. It is assumed that concentrations in mol/L is roughly equivalent to activity since ionic strength of groundwater is very low.
3. Major complexing ions (redox sensitive species Ca^{2+}, Cl^-, HCO3-, K^+, Mg^{2+}, Na^+, SO_4^{2-} and SeO_3^-) were speciated by reaction with species on both the x and y axes.
4. Formation of hematite and $FeSe_2$ were suppressed as they are not representative of site conditions.
5. Elemental iron (Fe) is shaded in pink. Aqueous species are shaded in blue.
6. Eh-pH diagram produced for iron at 25 °C

Abbreviations:
°C – degrees Celsius
µg/L – micrograms per liter
V – volts

Legend

- ■ YGWC-23S
- ● YGWC-38
- ▲ PZ-37
- ◆ YGWC-36
- ★ YGWC-41
- ▼ YGWC-42
- ■ YGWC-43
- ● PZ-35
- ○ YGWA-39
- △ YGWA-40

Georgia Power

PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

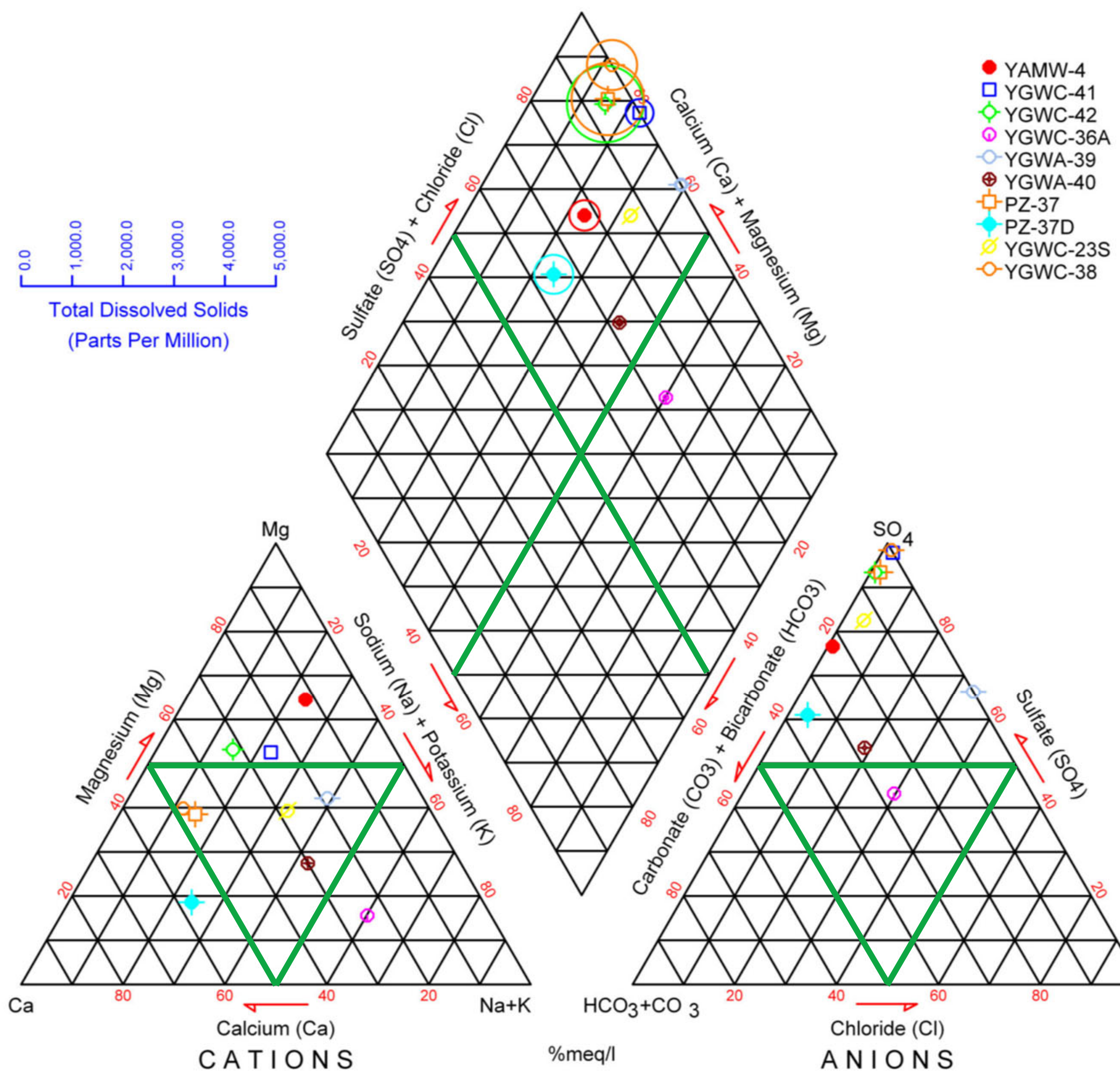
IRON SPECIATION DIAGRAM

ARCADIS

FIGURE
2.4

6/8/2022 8:35:44 AM

Piper Diagram



Notes:
% meq/l – percent milliequivalents per liter
Line representing 50 percent between endpoints

Georgia Power

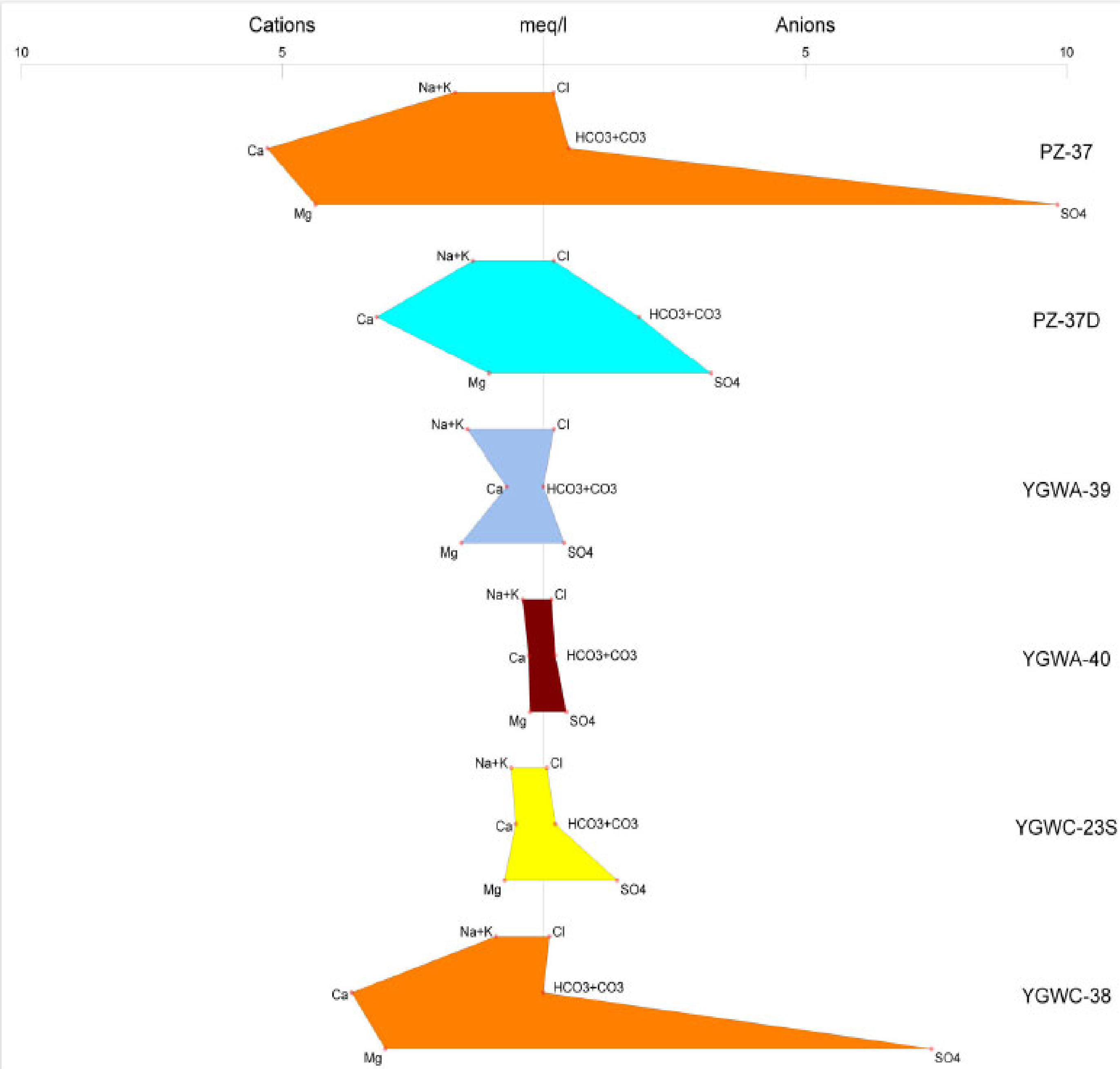
PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

PIPER DIAGRAM

ARCADIS

FIGURE
2.5

4/14/2022 1:57:22 PM



Notes:
Units are in milliequivalents per liter (meq/l)
Na+K = sodium + potassium
Ca = calcium
Mg = magnesium
Cl = chloride
HCO3 + CO3 = bicarbonate + carbonate
SO4 = sulfate

Georgia Power

PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

STIFF DIAGRAMS – SOUTHEASTERN BOUNDARY

ARCADIS

FIGURE
2.6A

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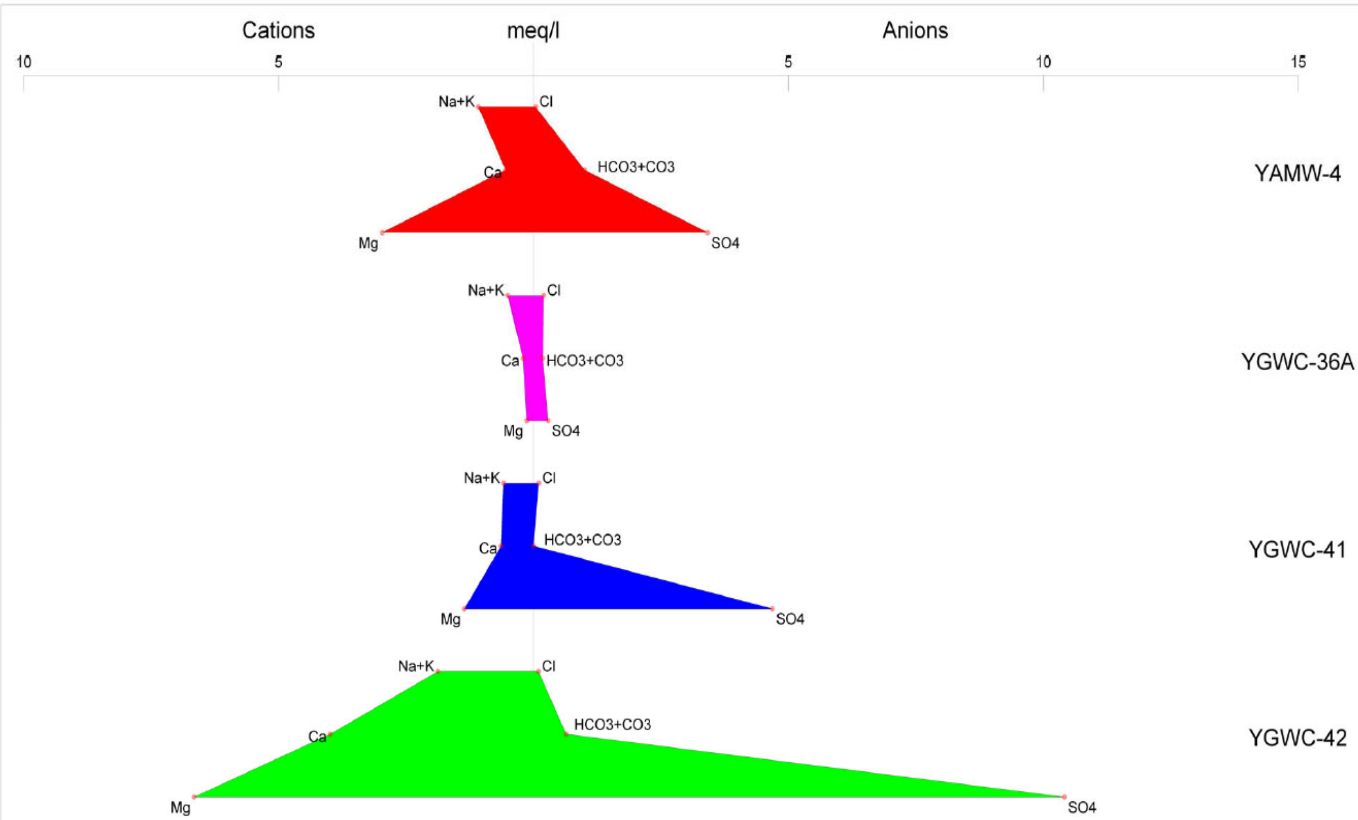


Notes:
Units are in milliequivalents per liter (meq/l)
Na+K = sodium + potassium
Ca = calcium
Mg = magnesium
Cl = chloride
HCO3 + CO3 = bicarbonate + carbonate
SO4 = sulfate

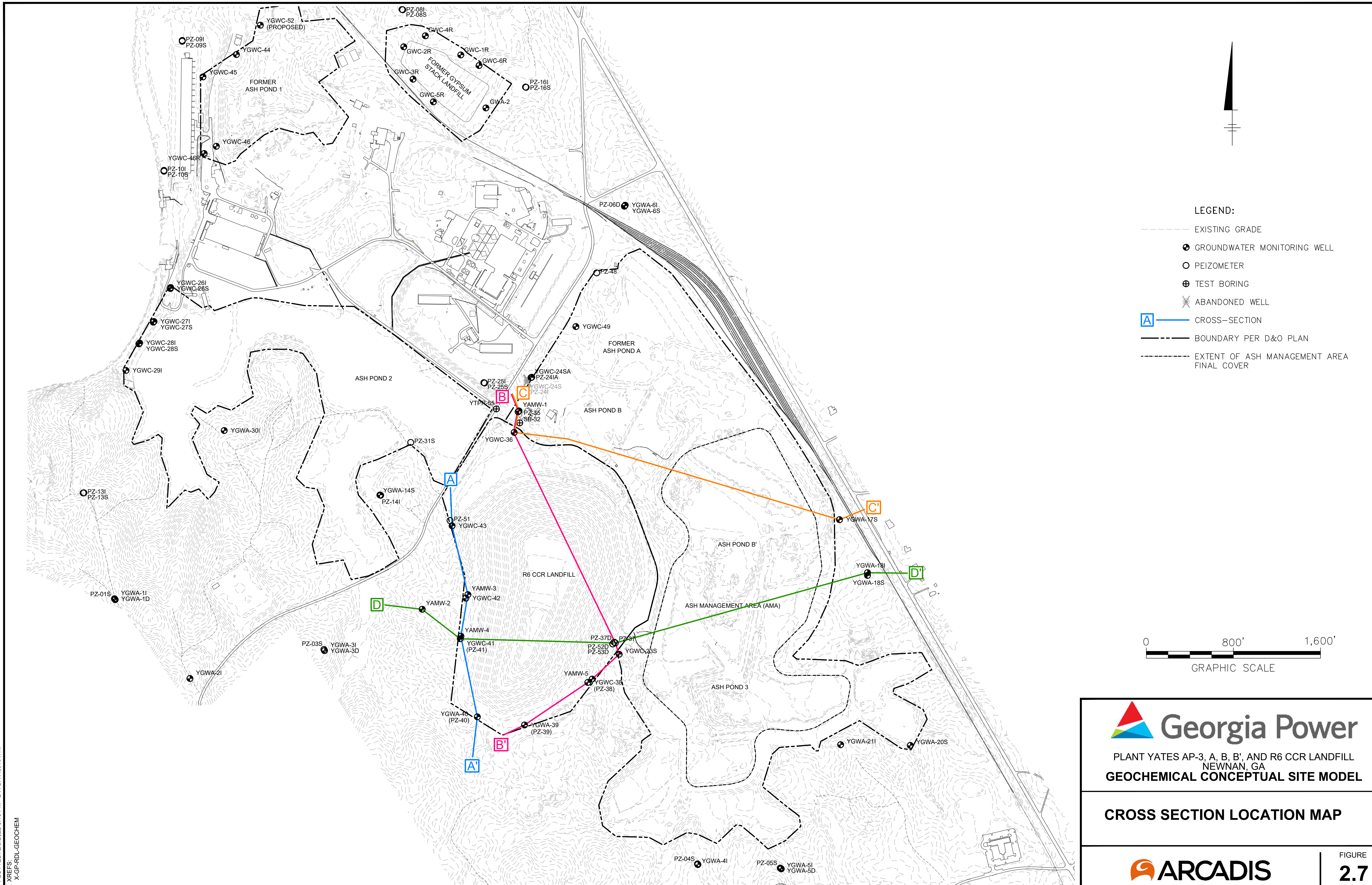
Georgia Power

PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

STIFF DIAGRAMS – WESTERN BOUNDARY

ARCADIS

FIGURE
2.6B



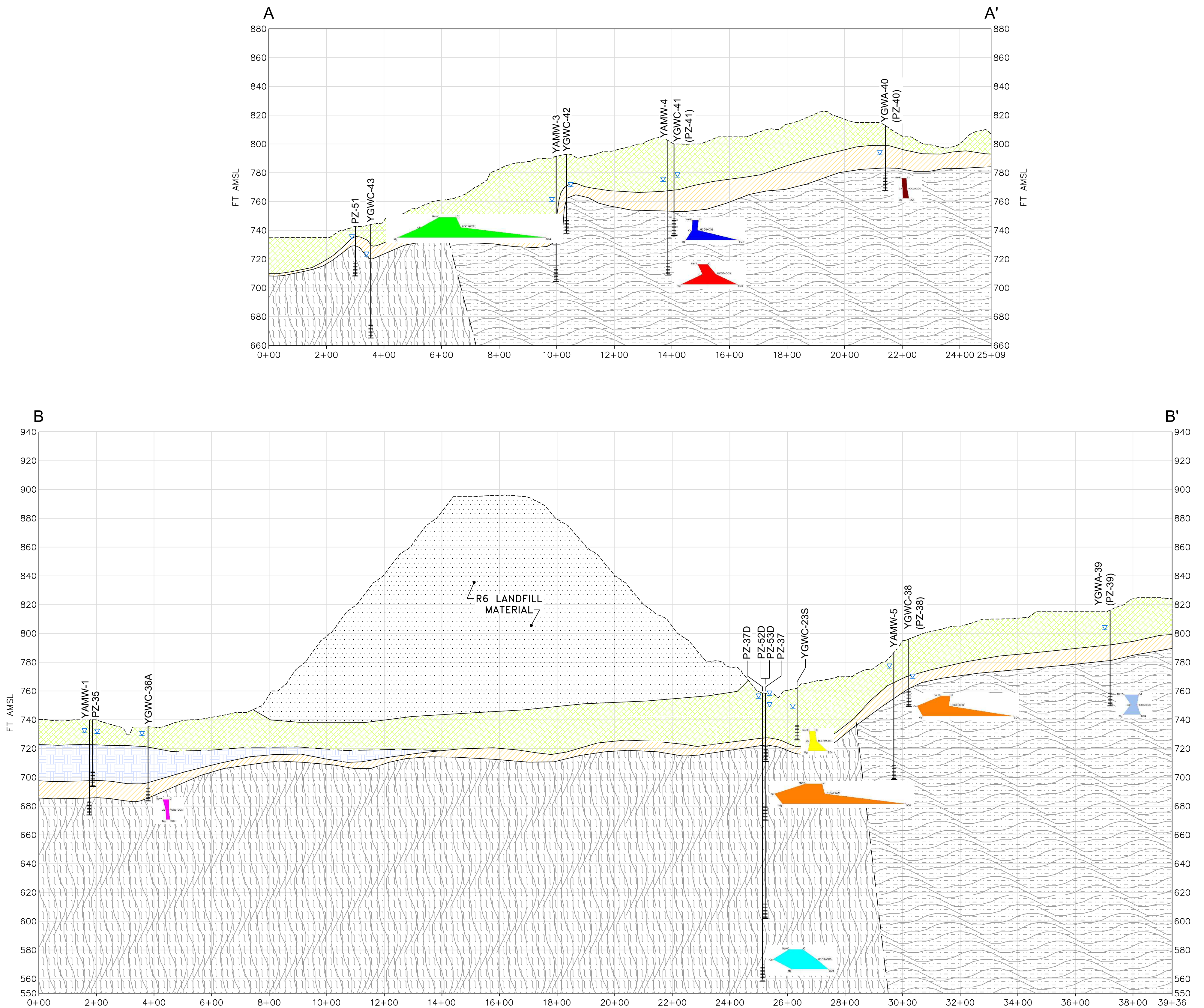
Georgia Power

PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL

CROSS SECTION LOCATION MAP

ARCADIS

FIGURE
2.7



LEGEND:

- WATER ELEVATION (AUGUST & NOVEMBER 2021)
- WELL SCREEN
- Ca CALCIUM
- Mg MAGNESIUM
- Na+K SODIUM–POTASSIUM ALLOY
- HCO3 BICARBONATE
- SO4 SULFATE
- Cl CHLORIDE
- SELENIUM–IMPACTED WELLS

SAPROLITE:

- SILTY SAND – LIGHT BROWN TO TAN FINE–MEDIUM GRAINED SAND WITH SILT. LOOSE
- CLAYEY SAND – MOTTLED TO BROWN, FINE TO MEDIUM GRAINED SAND WITH CLAY. LOOSE.

TRANSITION ZONE:

- HIGHLY WEATHERED AND HIGHLY FRACTURED BIOTITE GNEISS, GRANITIC GNEISS, AND MICA SCHIST. FINE TO COARSE SAND AND GRAVEL PRESENT

BEDROCK:

- BEDROCK (UNDIFFERENTIATED) – UNDIFFERENTIATED BIOTITE GNEISS, GRANITIC GNEISS, AND MICA SCHIST. MODERATELY TO INTENSELY FOLIATED
- BIOTITE GNEISS – BIOTITE AND MUSCOVITE GNEISS. MODERATELY TO INTENSELY FOLIATED

NOTES:

1. CROSS SECTION ELEVATIONS ARE MEASURED IN FEET ABOVE MEAN SEA LEVEL (AMSL).

0 400' 800'
HORIZONTAL GRAPHIC SCALE

0 80' 160'
VERTICAL GRAPHIC SCALE

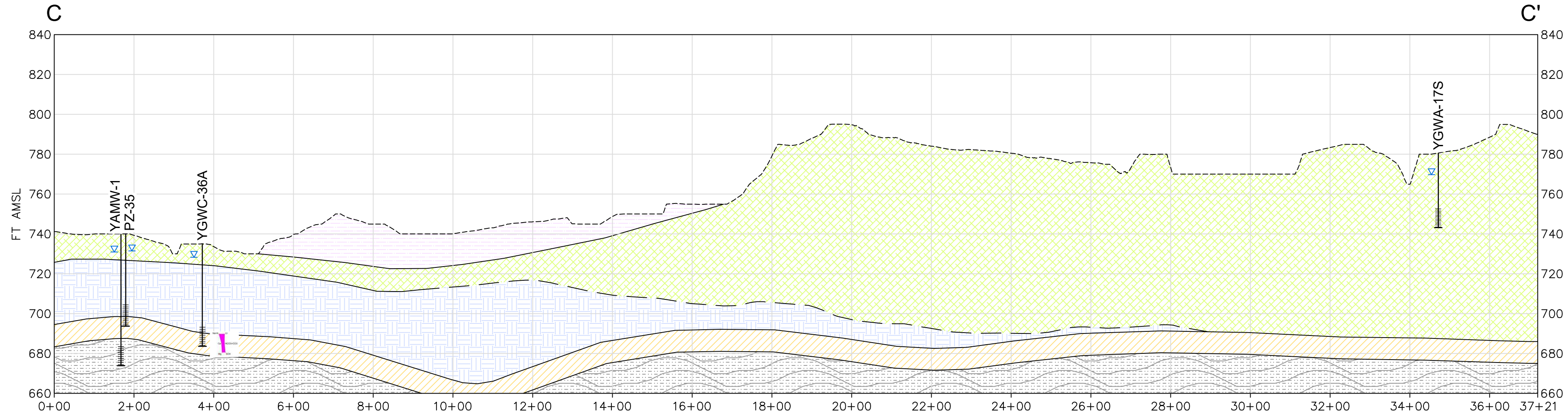
Georgia Power

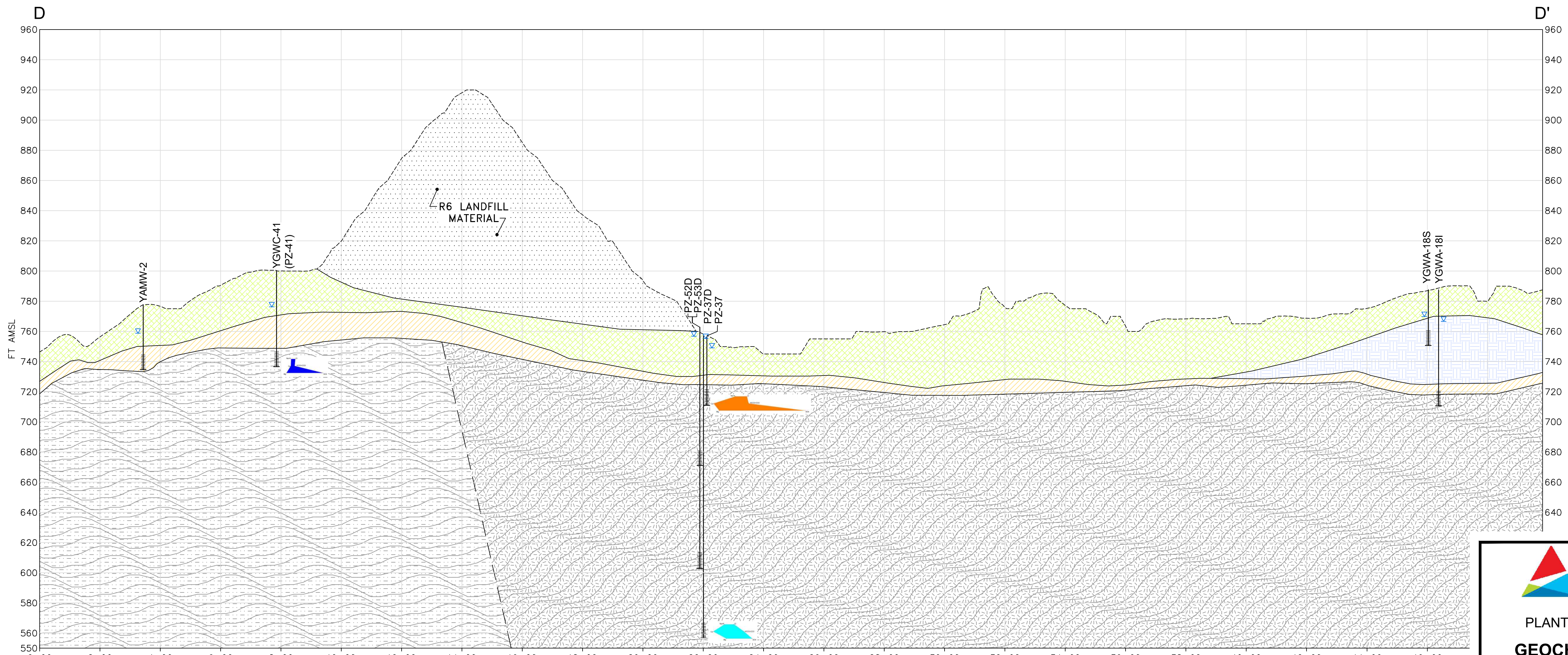
PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL

CROSS-SECTIONS A-A' AND B-B' WITH STIFF DIAGRAMS

ARCADIS

FIGURE
2.8





LEGEND:

WATER ELEVATION (AUGUST & NOVEMBER 2021)

WELL SCREEN

Ca CALCIUM

Mg MAGNESIUM

Na+K SODIUM–POTASSIUM ALLOY

HCO3 BICARBONATE

SO4 SULFATE

Cl CHLORIDE

SELENIUM–IMPACTED WELLS

SAPROLITE:

SANDY SILT– LIGHT BROWN TO BROWN SANDY SILT. LOW PLASTICITY

SILTY SAND – LIGHT BROWN TO TAN FINE–MEDIUM GRAINED SAND WITH SILT. LOOSE

CLAYEY SAND – MOTTLED TO BROWN, FINE TO MEDIUM GRAINED SAND WITH CLAY. LOOSE.

TRANSITION ZONE:

HIGHLY WEATHERED AND HIGHLY FRACTURED BIOTITE GNEISS, GRANITIC GNEISS, AND MICA SCHIST. FINE TO COARSE SAND AND GRAVEL PRESENT

BEDROCK:

GRANITIC GNEISS –GRAY TO WHITE, BIOTITE, MUSCOVITE, QUARTZ, PLAGIOCLASE GNEISS. MODERATELY TO INTENSELY FOLIATED

BIOTITE GNEISS – BIOTITE AND MUSCOVITE GNEISS. MODERATELY TO INTENSELY FOLIATED

NOTES:

1. CROSS SECTION ELEVATIONS ARE MEASURED IN FEET ABOVE MEAN SEA LEVEL (AMSL).

0 400' 800'
HORIZONTAL GRAPHIC SCALE

0 80' 160'
VERTICAL GRAPHIC SCALE

Georgia Power

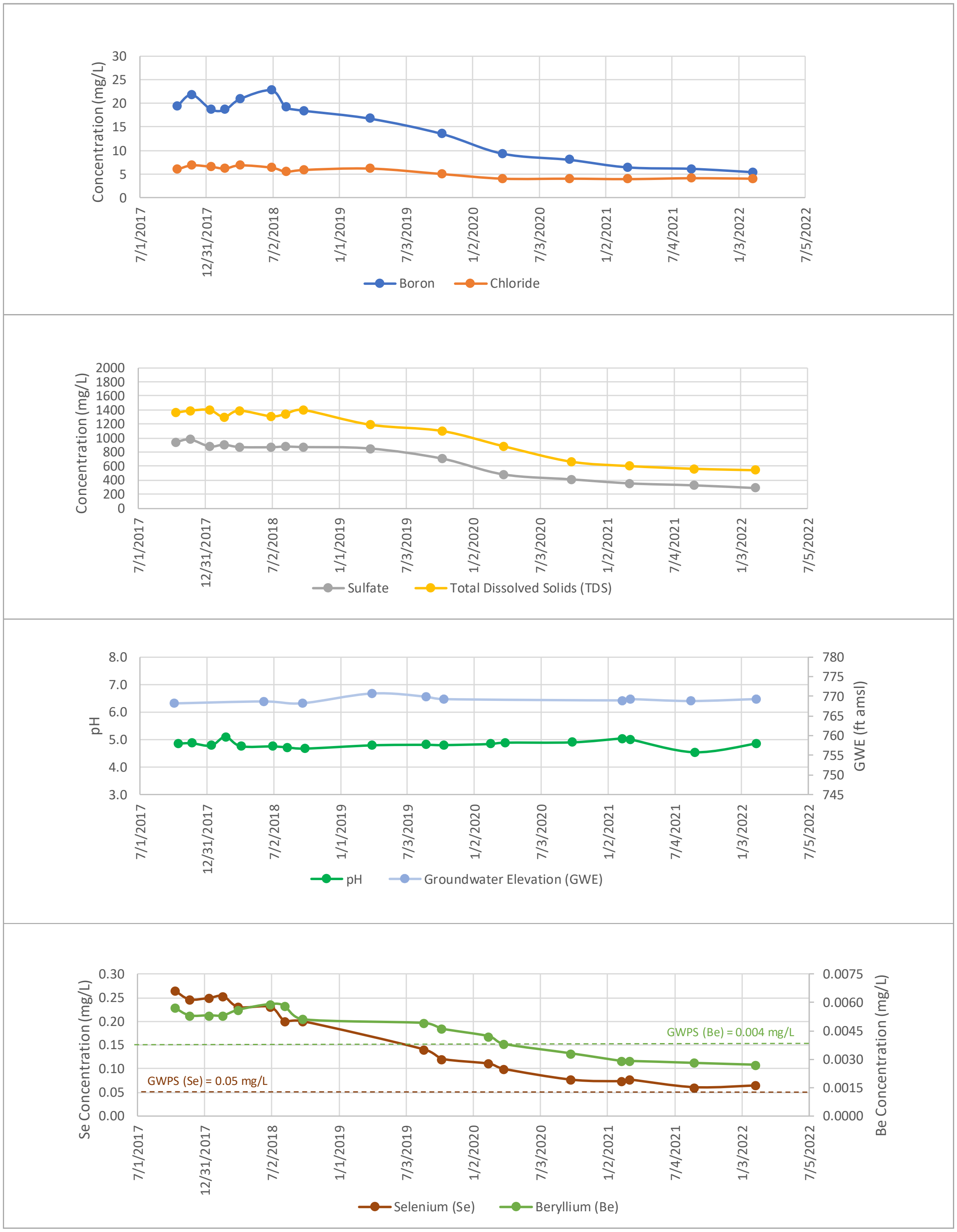
PLANT YATES AP-3, A, B, B', AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL

CROSS-SECTIONS C-C' AND D-D' WITH STIFF DIAGRAMS

ARCADIS

FIGURE
2.9

YGWC-38



Notes:
R6 CCR Landfill closure complete in 2016
ft amsl – feet above mean sea level
GWPS – groundwater protection standard
mg/L – milligrams per liter

Georgia Power

PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

YGWC-38 CONCENTRATION TRENDS

ARCADIS

FIGURE
2.10

4/13/2022 12:20:48 PM

YAMW-5

Notes:
R6 CCR Landfill closure complete in 2016
ft amsl – feet above mean sea level
GWPS – groundwater protection standard
mg/L – milligrams per liter

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PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

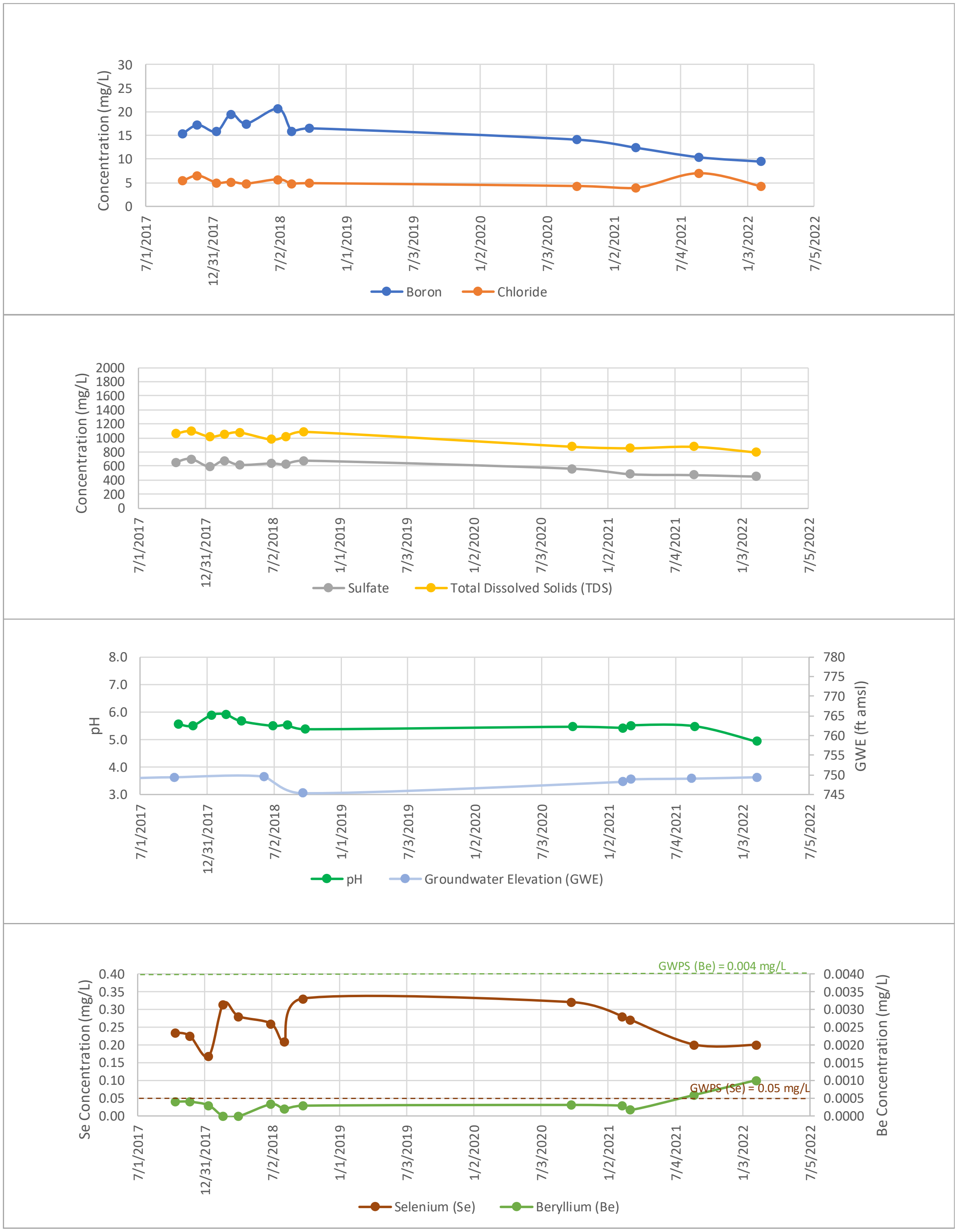
YAMW-5 CONCENTRATION TRENDS

ARCADIS

FIGURE
2.11

4/13/2022 12:21:23 PM

PZ-37



Notes:
R6 CCR Landfill closure complete in 2016
ft amsl – feet above mean sea level
GWPS – groundwater protection standard
mg/L – milligrams per liter

Georgia Power

PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

PZ-37 CONCENTRATION TRENDS

ARCADIS

FIGURE
2.12

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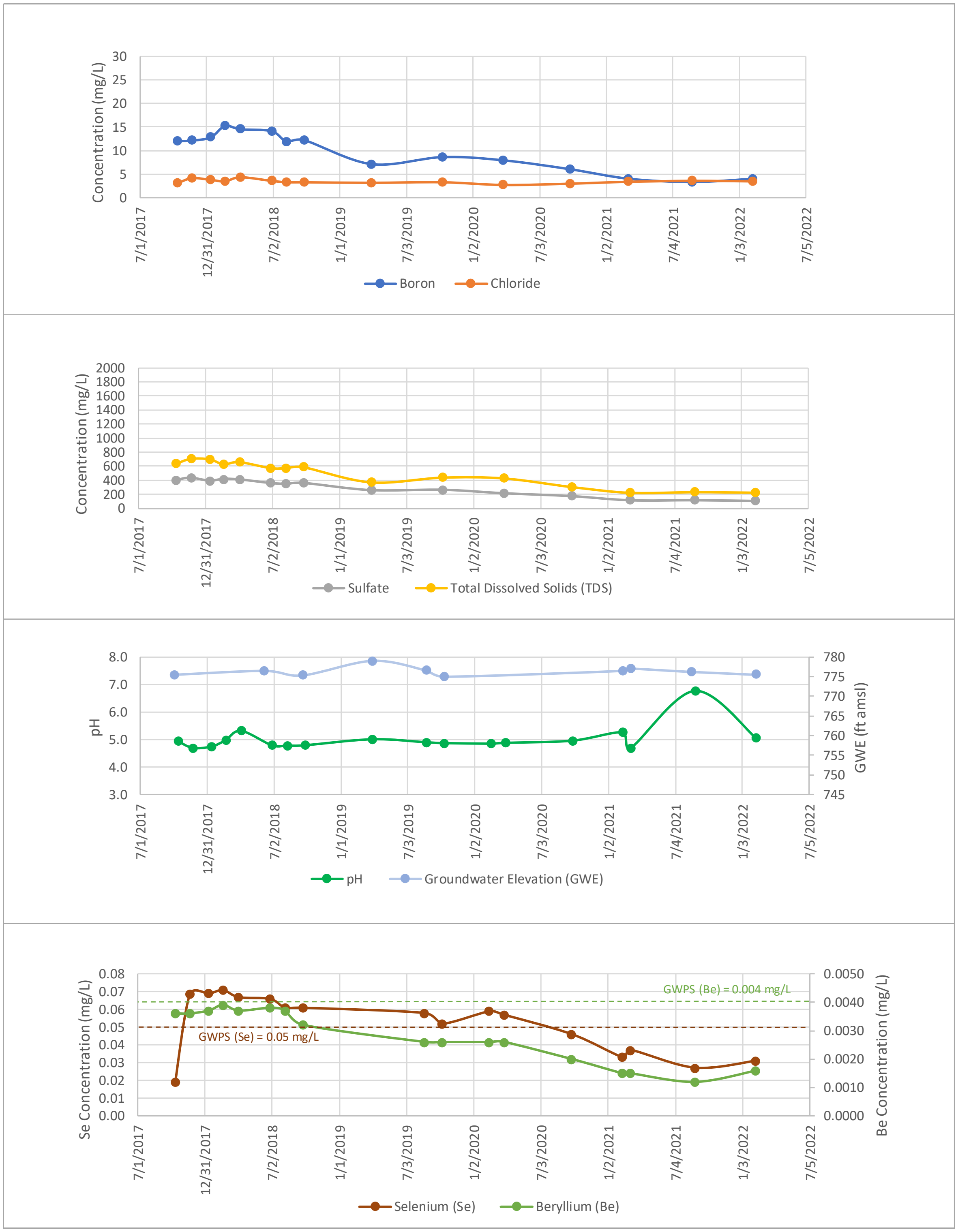
YGWC-41



Notes:
R6 CCR Landfill closure complete in 2016
ft amsl – feet above mean sea level
GWPS – groundwater protection standard
mg/L – milligrams per liter

Georgia Power

PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

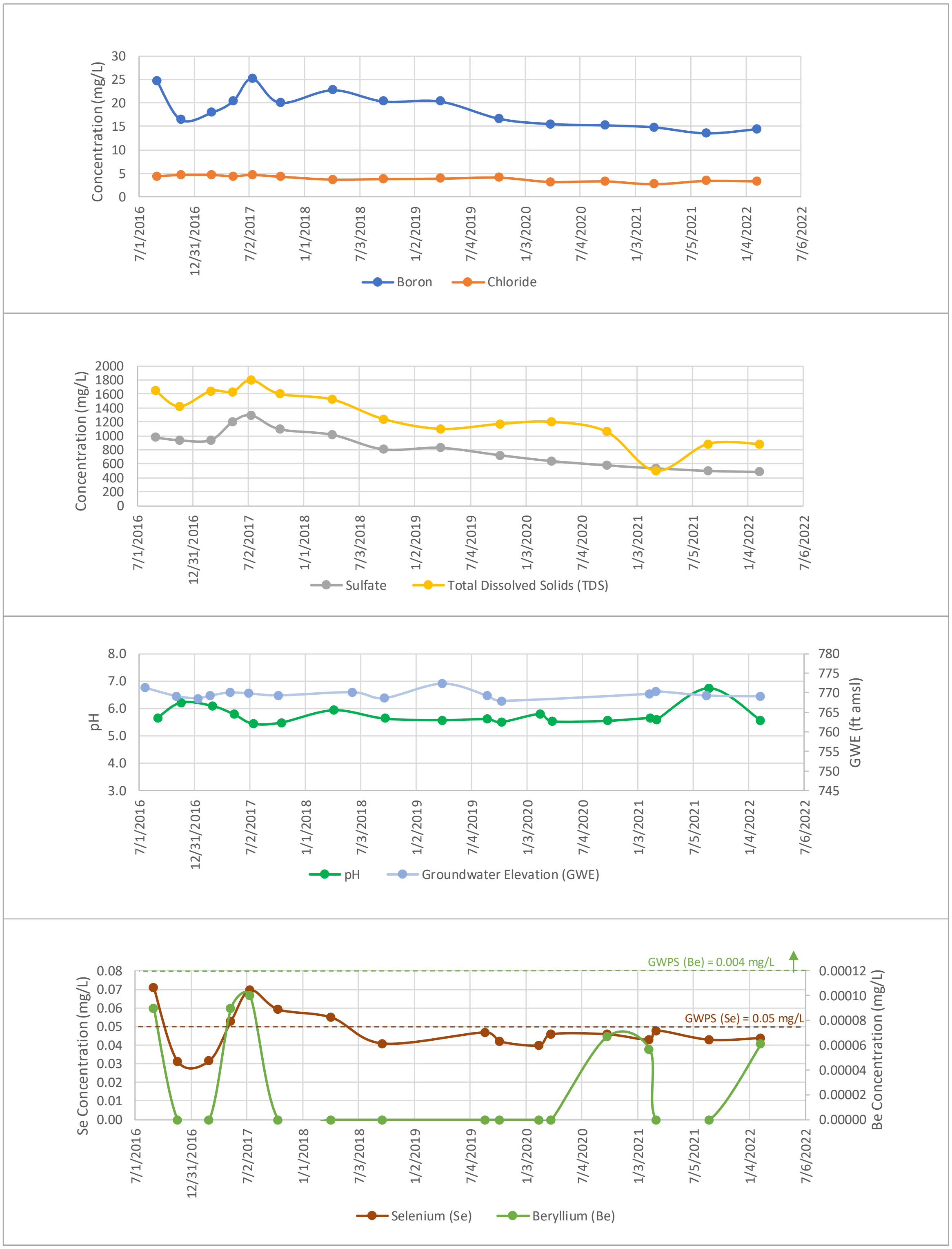
YGWC-41 CONCENTRATION TRENDS

ARCADIS

FIGURE
2.13

4/13/2022 12:22:11 PM

YGWC-42



Notes:
R6 CCR Landfill closure complete in 2016
ft amsl – feet above mean sea level
GWPS – groundwater protection standard
mg/L – milligrams per liter

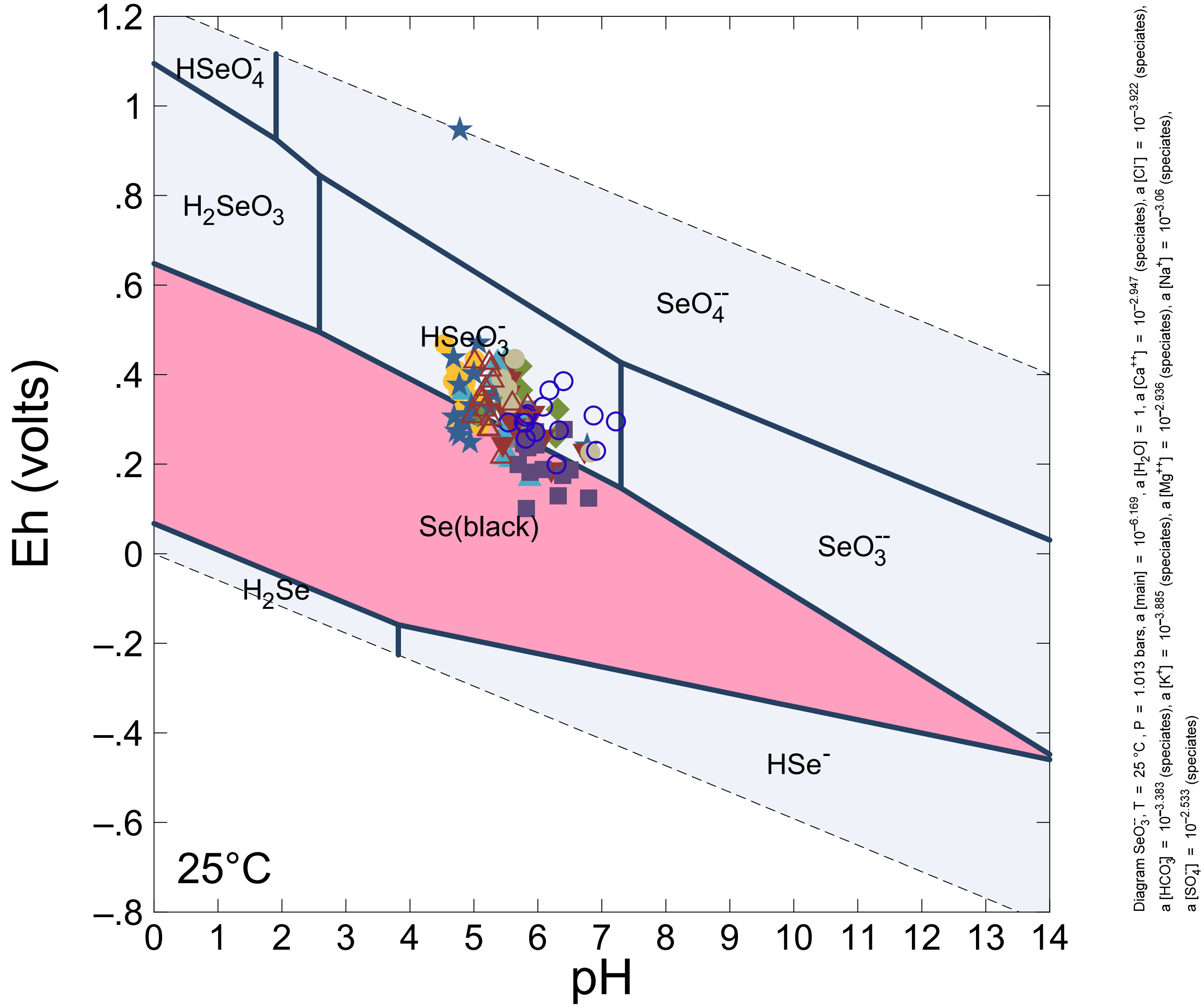
Georgia Power

PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

YGWC-42 CONCENTRATION TRENDS

ARCADIS

FIGURE
2.14



Notes:
1. This Eh-pH diagram was produced with Geochemist's Workbench. The LLNL thermodynamic database, "thermo.tdat", the program's default database, was used.
2. The basis species in the LLNL thermodynamic database for selenium (SeO_3^{2-}) was used to construct the Eh-pH diagram. Representative value of all wells included in this figure (6.8e-7 mol/L) was used. Units needed to create Eh-pH diagram is activity. It is assumed that concentrations in mol/L is roughly equivalent to activity since ionic strength of groundwater is very low.
3. Major complexing ions (redox sensitive species Ca^{2+}, Cl^-, HCO3$^-$, K^+, Mg^{2+}, Na^+, SO4^{2-}) were speciated by reaction with species on both the x and y axes.
4. Elemental selenium (Se) is shaded in pink. Aqueous species are shaded in blue.
5. Eh-pH diagram produced for selenium at 25 ^{o}C

Abbreviations:
^{o}C – degrees Celsius
µg/L – micrograms per liter
V – volts

Legend

- YGWC-23S
- YGWC-38
- PZ-37
- YGWC-36
- YGWC-41
- YGWC-42
- YGWC-43
- PZ-35
- YGWA-39
- YGWA-40

Georgia Power

PLANT YATES AP-3, A, B, B' AND R6 CCR LANDFILL
NEWNAN, GA
GEOCHEMICAL CONCEPTUAL SITE MODEL REPORT

SELENIUM SPECIATION DIAGRAM

ARCADIS

FIGURE
3.1

4/15/2022 3:19:51 PM

Attachment 1

Analytical Laboratory Reports

Semi-Quantitative X-Ray Diffraction

Report Prepared for:	*Arcadis US Inc*
Project Number/ LIMS No.	*18122-01/MI4505-OCT20*
Sample Receipt:	*October 14, 2020*
Sample Analysis:	*October 15, 2020*
Reporting Date:	*November 12, 2020*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 35 kV, 40 mA Regular Scanning: Step: 0.02°, Step time:0.2s, 2θ range: 3-70°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

Method Summary

The Semi-Quantitative Mineral Identification by XRD (ME-LR-MIN-MET-MN-D03) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involve matching the diffraction pattern of a test sample material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) and released on software as a database of Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds. Mineral proportions are based on relative peak heights and may be strongly influenced by crystallinity, structural group or preferred orientations. Interpretations and relative proportions should be accompanied by supporting petrographic and geochemical data (Whole Rock Analysis, Inductively Coupled Plasma - Optical Emission Spectroscopy, etc.).

Semi-Quantitative Analysis:

The Semi-Quantitative analysis (RIR method) is performed based on each mineral's relative peak heights and of their respective I/Icor values, which are available from the PDF database. Mineral abundances for the bulk sample (in weight %) are generated by Bruker-EVA Software. These data are reconciled with a bulk chemistry (e.g. whole rock analysis including SiO_2, Al_2O_3, Na_2O, K_2O, CaO, MgO, Fe_2O_3, Cr_2O_3, MnO, TiO_2, P_2O_5, V_2O_5 or other chemical data). A chemical balance table shows the difference between the assay results and elemental concentrations determined by XRD.

Semi-Quantitative X-ray Diffraction Results

Mineral	YGWC-24SA (10-44) (wt %)	YGWC-24SA (47-49) (wt %)	YGWC-24SA (52-54) (wt %)	YAMW-3 (83-84) (wt %)	YAMW-4 (88-89) (wt %)	YGWC-38 (26-27) (wt %)	YGWC-38 (39-40) (wt %)	YGWC-38 (59.5-60.5) (wt %)	YGWC-41 (32-33) (wt %)	YGWC-41 (48-49) (wt %)	YGWC-41 (59-60) (wt %)
Quartz	46.7	41.7	49.2	53.0	36.9	51.6	43.6	49.9	49.5	46.1	51.7
Albite	26.8	29.5	34.8	29.6	49.1	30.3	39.4	31.7	31.5	39.6	29.9
Albite, calcian	6.4	7.0	2.4	4.9	7.1	6.3	5.3	6.3	6.9	2.5	8.7
Muscovite	11.9	11.9	7.2	7.5	1.8	5.4	6.4	6.8	6.7	4.7	5.5
Biotite	2.2	0.8	1.0	5.0	2.8	1.2	4.4	5.0	-	5.6	4.3
Hydrobiotite	1.1	4.7	1.7	-	-	0.9	-	-	4.0	-	-
Clinochlore	1.0	1.3	1.5	-	2.4	1.1	0.9	0.3	1.4	1.4	-
Kaolinite	2.3	1.4	1.6	-	-	2.2	-	-	-	-	-
Antigorite	1.5	1.7	0.6	-	-	1.0	-	-	-	-	-
TOTAL	100	100	100	100	100	100	100	100	100	100	100

Mineral	Composition
Quartz	SiO_2
Albite	$NaAlSi_3O_8$
Albite, calcian	$(Na,Ca)Al(Si,Al)_3O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Hydrobiotite	$K(Mg,Fe)_6(Si,Al,Fe)_8O_{20}(OH)_4{\cdot}4H_2O$
Clinochlore	$(Fe,Mg)_5Al(Si_3Al)O_{10}(OH)_8$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Antigorite	$Mg_3Si_2O_5(OH)_4$

Chemical Balance

YGWC-24SA (10-44)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	36.6	35.4	1.25	Both
Aluminum	7.41	7.63	-0.22	Both
Iron	1.50	1.09	0.41	Both
Potassium	1.22	1.18	0.04	Both
Magnesium	0.62	0.67	-0.05	Both
Calcium	0.45	0.48	-0.03	Both
Titanium	0.08	-	0.08	XRF
Manganese	0.05	-	0.05	XRF
Barium	0.04	-	0.04	XRF
Hydrogen	-	0.16	-0.16	SQD
Oxygen	-	50.7	-50.7	SQD
Sodium	-	2.75	-2.75	SQD

YGWC-24SA (47-49)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	34.5	33.9	0.65	Both
Aluminum	7.82	8.09	-0.27	Both
Iron	1.98	1.90	0.08	Both
Potassium	1.54	1.21	0.33	Both
Magnesium	1.06	0.91	0.15	Both
Calcium	0.45	0.52	-0.07	Both
Titanium	0.10	-	0.10	XRF
Manganese	0.09	-	0.09	XRF
Barium	0.04	-	0.04	XRF
Hydrogen	-	0.18	-0.18	SQD
Oxygen	-	50.3	50.3	SQD
Sodium	-	3.01	3.01	SQD

1. Values measured by chemical assay. Reported in weight percent.

2. Values calculated based on mineral/compound formulas and quantites identified by semi-quantitative XRD.

Chemical Balance

YGWC-24SA (52-54)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	36.6	37.0	-0.41	Both
Aluminum	6.57	6.41	0.16	Both
Iron	1.12	1.03	0.09	Both
Potassium	0.77	0.73	0.04	Both
Magnesium	0.51	0.44	0.07	Both
Calcium	0.33	0.18	0.15	Both
Titanium	0.05	-	0.05	XRF
Manganese	0.04	-	0.04	XRF
Barium	0.02	-	0.02	XRF
Hydrogen	-	0.11	-0.11	SQD
Oxygen	-	50.9	50.9	SQD
Sodium	-	3.23	3.23	SQD

YAMW-3 (83-84)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	36.7	37.6	-0.85	Both
Aluminum	5.98	6.08	-0.10	Both
Iron	0.90	0.93	-0.03	Both
Potassium	0.87	1.03	-0.16	Both
Magnesium	0.53	0.39	0.14	Both
Calcium	0.36	0.37	-0.01	Both
Titanium	0.05	-	0.05	XRF
Manganese	0.02	-	0.02	XRF
Chromium	0.02	-	0.02	XRF
Hydrogen	-	0.06	-0.06	SQD
Oxygen	-	50.7	50.7	SQD
Sodium	-	2.88	2.88	SQD

1. Values measured by chemical assay. Reported in weight percent.

2. Values calculated based on mineral/compound formulas and quantites identified by semi-quantitative XRD.

Chemical Balance

YAMW-4 (88-89)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	36.6	35.2	1.40	Both
Aluminum	7.01	7.76	-0.75	Both
Iron	0.66	1.09	-0.43	Both
Magnesium	0.49	0.33	0.16	Both
Calcium	0.47	0.53	-0.06	Both
Potassium	0.37	0.37	0.00	Both
Titanium	0.05	-	0.05	XRF
Manganese	0.05	-	0.05	XRF
Hydrogen	-	0.05	-0.05	SQD
Oxygen	-	50.1	-50.1	SQD
Sodium	-	4.62	-4.62	SQD

YGWC-38 (26-27)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	37.8	37.1	0.69	Both
Aluminum	6.33	6.47	-0.14	Both
Iron	1.06	0.62	0.44	Both
Potassium	0.64	0.57	0.07	Both
Magnesium	0.43	0.61	-0.18	Both
Calcium	0.34	0.47	-0.13	Both
Titanium	0.05	-	0.05	XRF
Barium	0.02	-	0.02	XRF
Manganese	0.02	-	0.02	XRF
Hydrogen	-	0.11	-0.11	SQD
Oxygen	-	51.1	51.1	SQD
Sodium	-	2.98	2.98	SQD

1. Values measured by chemical assay. Reported in weight percent.

2. Values calculated based on mineral/compound formulas and quantites identified by semi-quantitative XRD.

Chemical Balance

YGWC-38 (39-40)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	37.0	36.1	0.86	Both
Aluminum	6.66	7.00	-0.34	Both
Potassium	0.98	0.88	0.11	Both
Iron	0.93	1.08	-0.15	Both
Magnesium	0.43	0.41	0.02	Both
Calcium	0.41	0.40	0.01	Both
Titanium	0.04	-	0.04	XRF
Barium	0.02	-	0.02	XRF
Manganese	0.02	-	0.02	XRF
Hydrogen	-	0.06	-0.06	SQD
Oxygen	-	50.3	50.3	SQD
Sodium	-	3.75	3.75	SQD

YGWC-38 (59.5-60.5)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	37.2	36.9	0.34	Both
Aluminum	6.67	6.53	0.14	Both
Iron	1.01	1.24	-0.23	Both
Potassium	0.75	0.96	-0.21	Both
Calcium	0.63	0.47	0.16	Both
Magnesium	0.27	0.29	-0.02	Both
Titanium	0.06	-	0.06	XRF
Manganese	0.03	-	0.03	XRF
Barium	0.03	-	0.03	XRF
Hydrogen	-	0.06	-0.06	SQD
Oxygen	-	50.5	50.5	SQD
Sodium	-	3.12	3.12	SQD

1. Values measured by chemical assay. Reported in weight percent.

2. Values calculated based on mineral/compound formulas and quantites identified by semi-quantitative XRD.

Chemical Balance

YGWC-41 (32-33)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	36.3	36.6	-0.32	Both
Aluminum	6.18	6.37	-0.19	Both
Iron	1.52	1.30	0.22	Both
Potassium	0.82	0.70	0.13	Both
Calcium	0.67	0.51	0.16	Both
Magnesium	0.58	0.58	0.00	Both
Titanium	0.08	-	0.08	XRF
Manganese	0.05	-	0.05	XRF
Barium	0.02	-	0.02	XRF
Hydrogen	-	0.10	-0.10	SQD
Oxygen	-	50.7	50.7	SQD
Sodium	-	3.13	3.13	SQD

YGWC-41 (48-49)

Name	Assay[1]	SQD[2]	Delta	Status
Silicon	35.2	36.8	-1.63	Both
Aluminum	6.01	6.23	-0.22	Both
Iron	0.93	1.29	-0.36	Both
Potassium	0.79	0.86	-0.07	Both
Magnesium	0.66	0.55	0.11	Both
Calcium	0.11	0.19	-0.08	Both
Titanium	0.05	-	0.05	XRF
Barium	0.02	-	0.02	XRF
Manganese	0.02	-	0.02	XRF
Hydrogen	-	0.07	-0.07	SQD
Oxygen	-	50.4	50.4	SQD
Sodium	-	3.63	3.63	SQD

YGWC-41 (59-60)

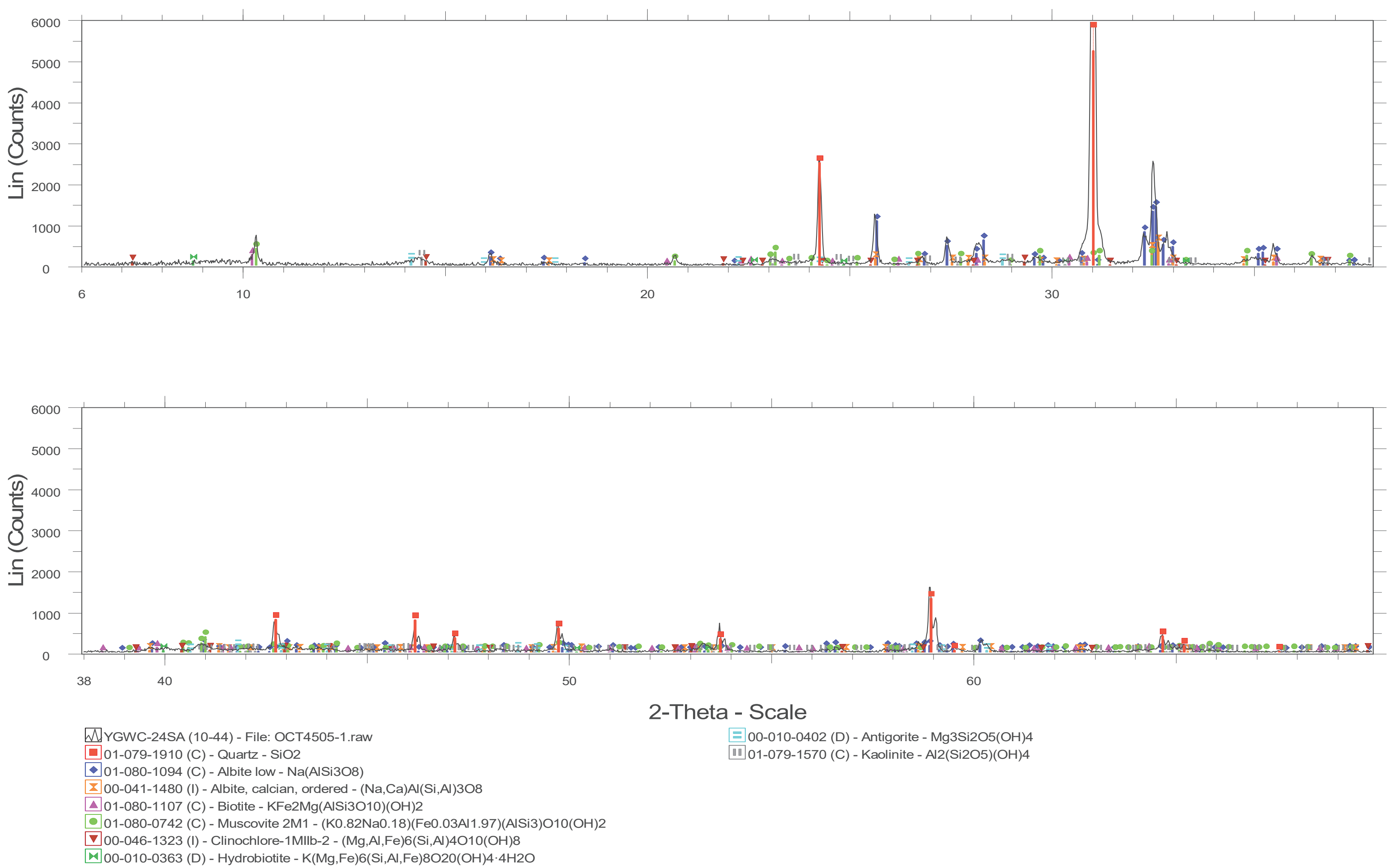
Name	Assay[1]	SQD[2]	Delta	Status
Silicon	37.1	37.0	0.07	Both
Aluminum	6.55	6.60	-0.05	Both
Iron	0.93	1.01	-0.08	Both
Potassium	0.65	0.79	-0.14	Both
Calcium	0.63	0.65	-0.02	Both
Magnesium	0.34	0.22	0.13	Both
Titanium	0.06	-	0.06	XRF
Barium	0.02	-	0.02	XRF
Manganese	0.02	-	0.02	XRF
Hydrogen	-	0.05	-0.05	SQD
Oxygen	-	50.6	50.6	SQD
Sodium	-	3.05	3.05	SQD

1. Values measured by chemical assay. Reported in weight percent.

2. Values calculated based on mineral/compound formulas and quantites identified by semi-quantitative XRD.

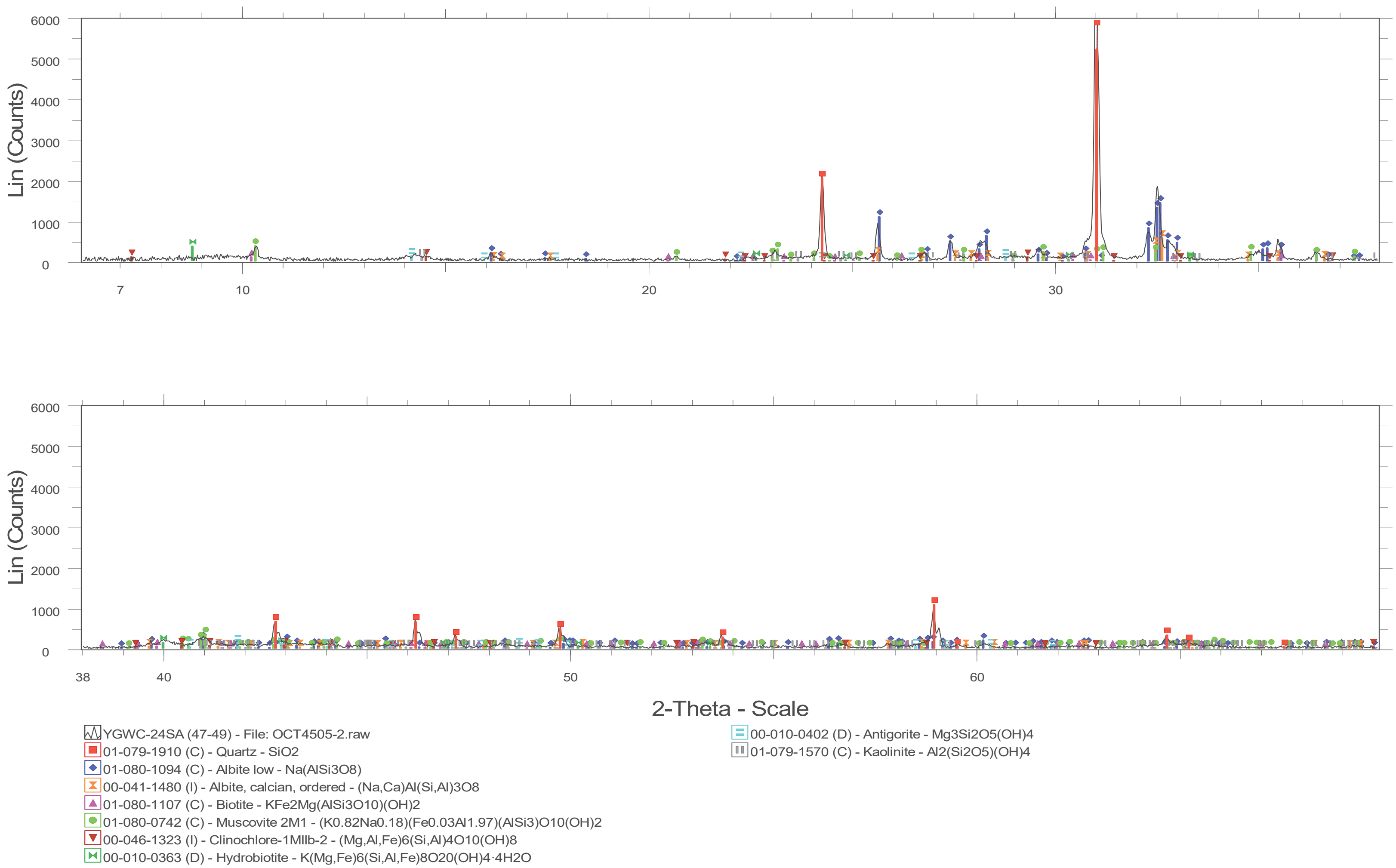
Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

YGWC-24SA (10-44)

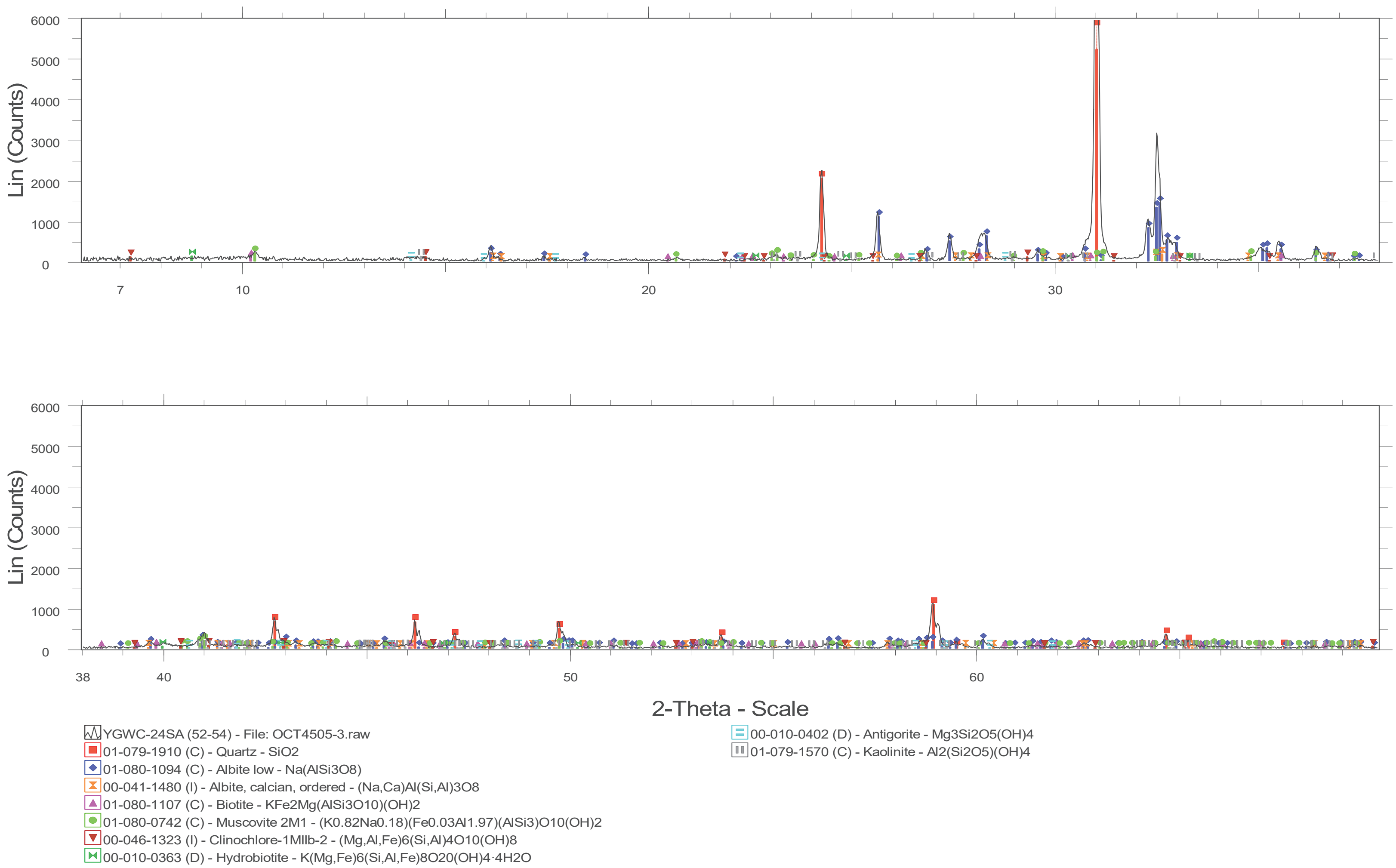


Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

YGWC-24SA (47-49)

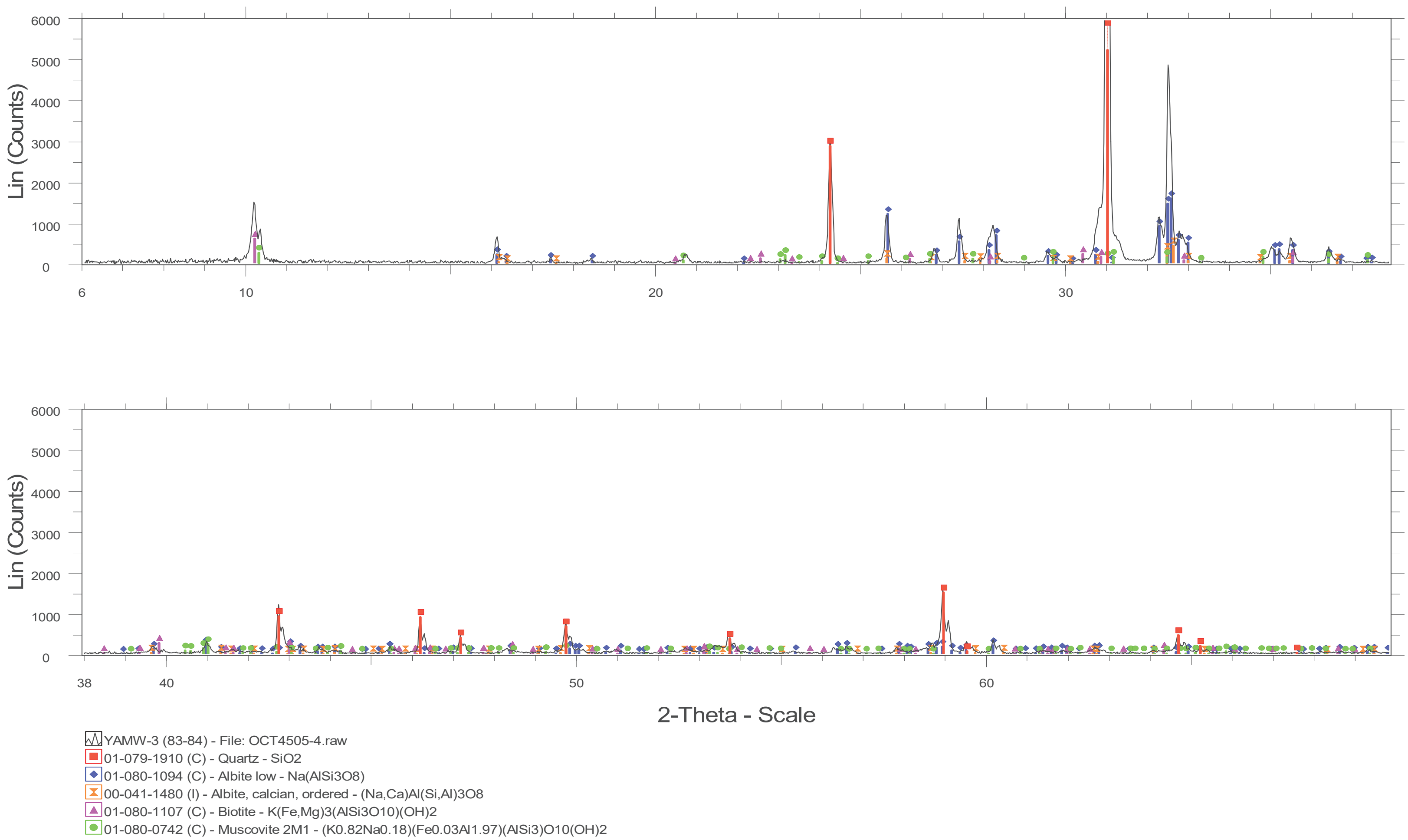


YGWC-24SA (52-54)



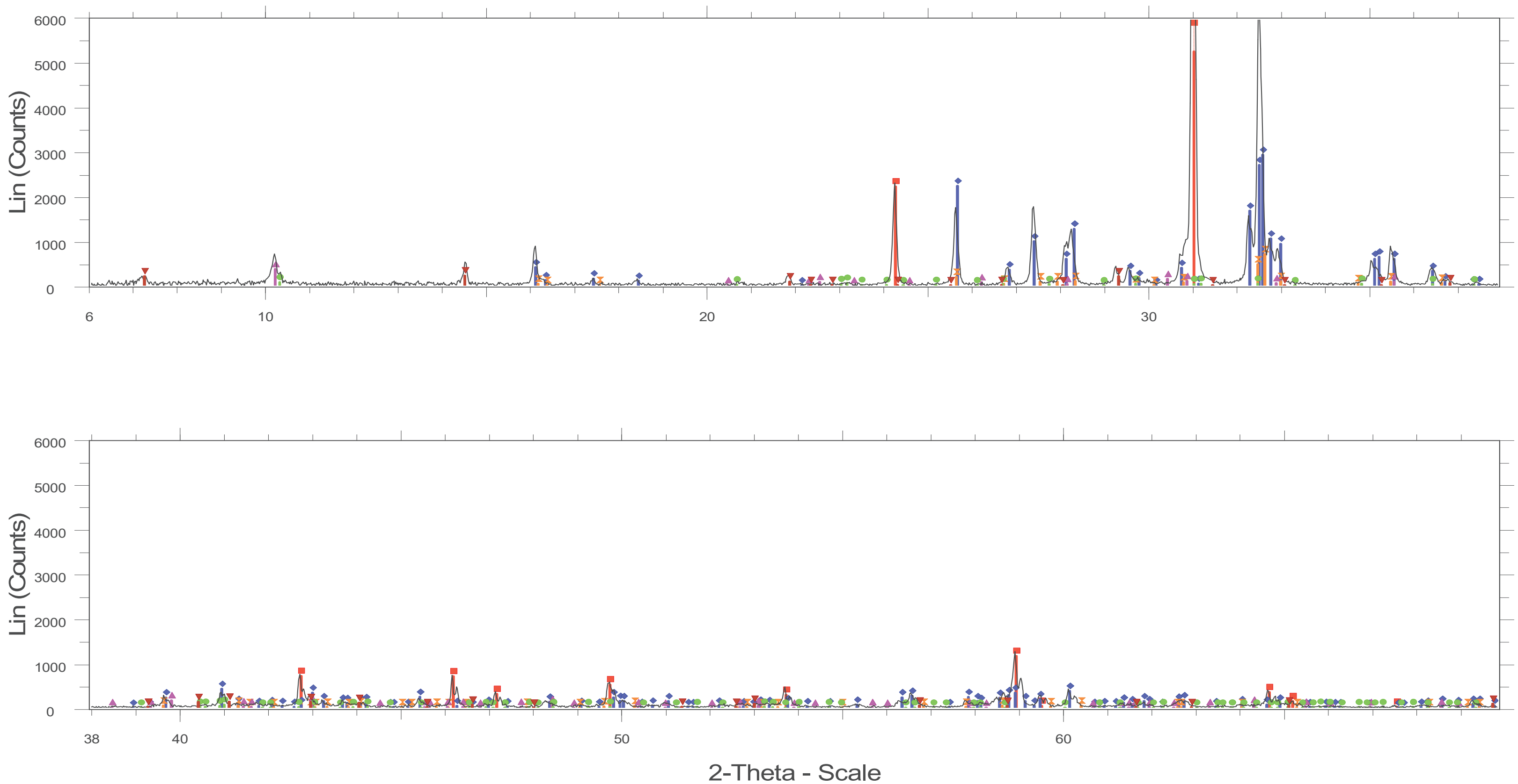
Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

YAMW-3 (83-84)



Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

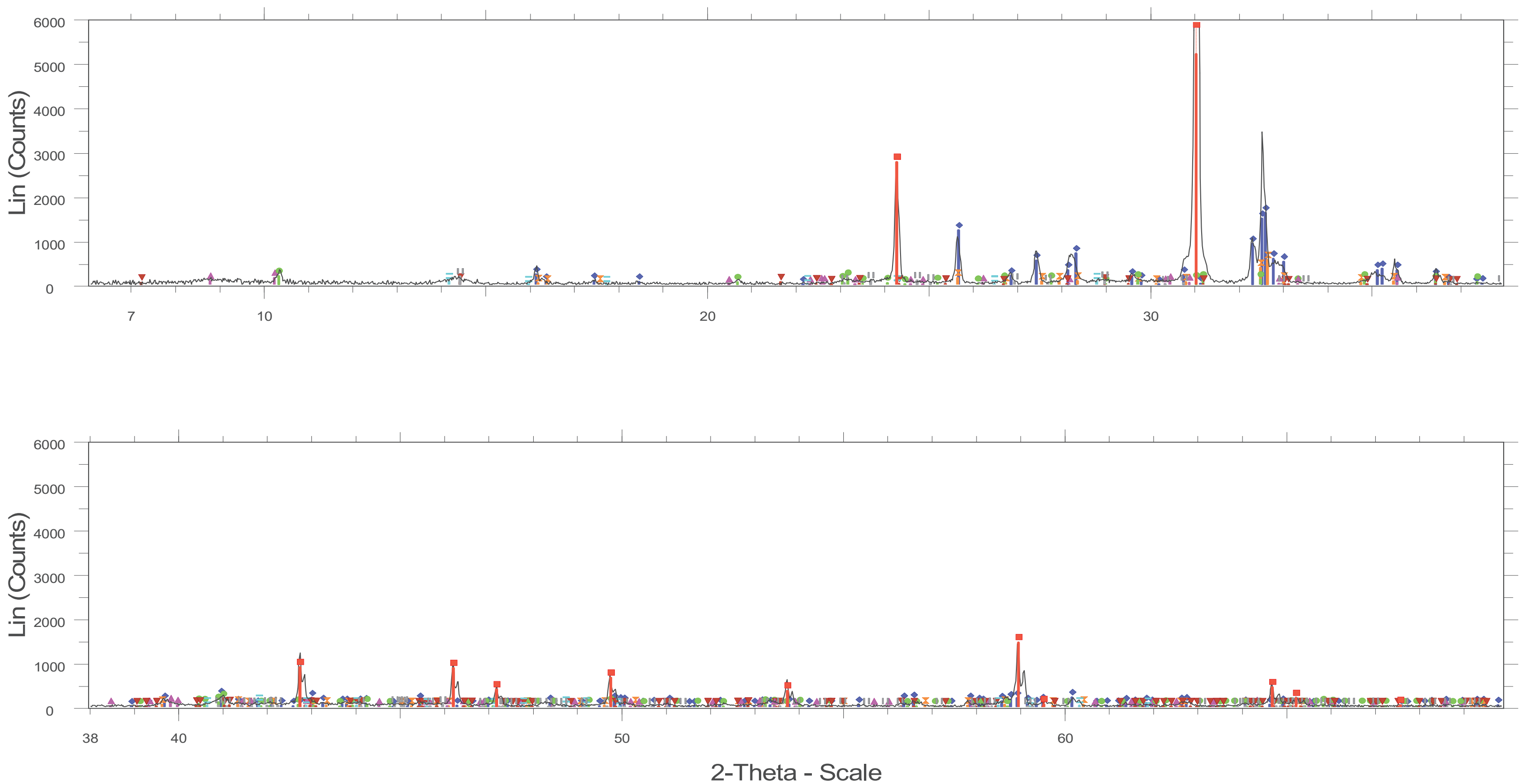
YAMW-4 (88-89)



YAMW-4 (88-89) - File: OCT4505-5.raw
01-079-1910 (C) - Quartz - SiO_2
01-080-1094 (C) - Albite low - $Na(AlSi_3O_8)$
00-041-1480 (I) - Albite, calcian, ordered - $(Na,Ca)Al(Si,Al)_3O_8$
01-080-1107 (C) - Biotite - $KFe_2Mg(AlSi_3O_{10})(OH)_2$
01-080-0742 (C) - Muscovite 2M1 - $(K_{0.82}Na_{0.18})(Fe_{0.03}Al_{1.97})(AlSi_3)O_{10}(OH)_2$
00-046-1323 (I) - Clinochlore-1MIIb-2 - $(Mg,Al,Fe)_6(Si,Al)_4O_{10}(OH)_8$

Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

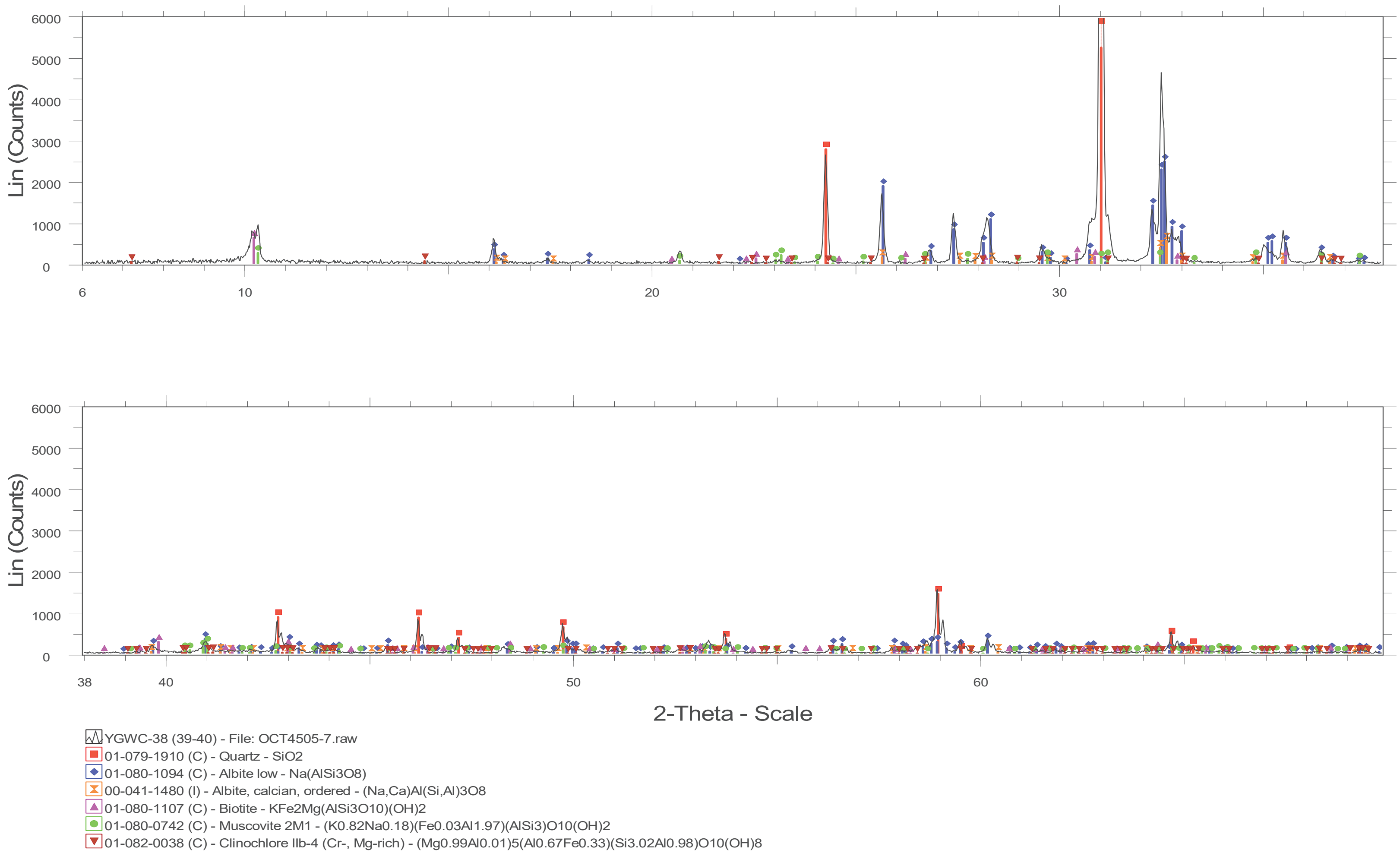
YGWC-38 (26-27)



YGWC-38 (26-27) - File: OCT4505-6.raw
01-079-1910 (C) - Quartz - SiO_2
01-080-1094 (C) - Albite low - $Na(AlSi_3O_8)$
00-041-1480 (I) - Albite, calcian, ordered - $(Na,Ca)Al(Si,Al)_3O_8$
01-080-1107 (C) - Biotite - $KFe_2Mg(AlSi_3O_{10})(OH)_2$
01-080-0742 (C) - Muscovite 2M1 - $(K_{0.82}Na_{0.18})(Fe_{0.03}Al_{1.97})(AlSi_3)O_{10}(OH)_2$
01-082-0038 (C) - Clinochlore IIb-4 (Cr-, Mg-rich) - $(Mg_{0.99}Al_{0.01})_5(Al_{0.67}Fe_{0.33})(Si_{3.02}Al_{0.98})O1$
00-010-0363 (D) - Hydrobiotite - $K(Mg,Fe)_6(Si,Al,Fe)_8O_{20}(OH)_4 \cdot 4H_2O$
00-010-0402 (D) - Antigorite - $Mg_3Si_2O_5(OH)_4$
01-079-1570 (C) - Kaolinite - $Al_2(Si_2O_5)(OH)_4$

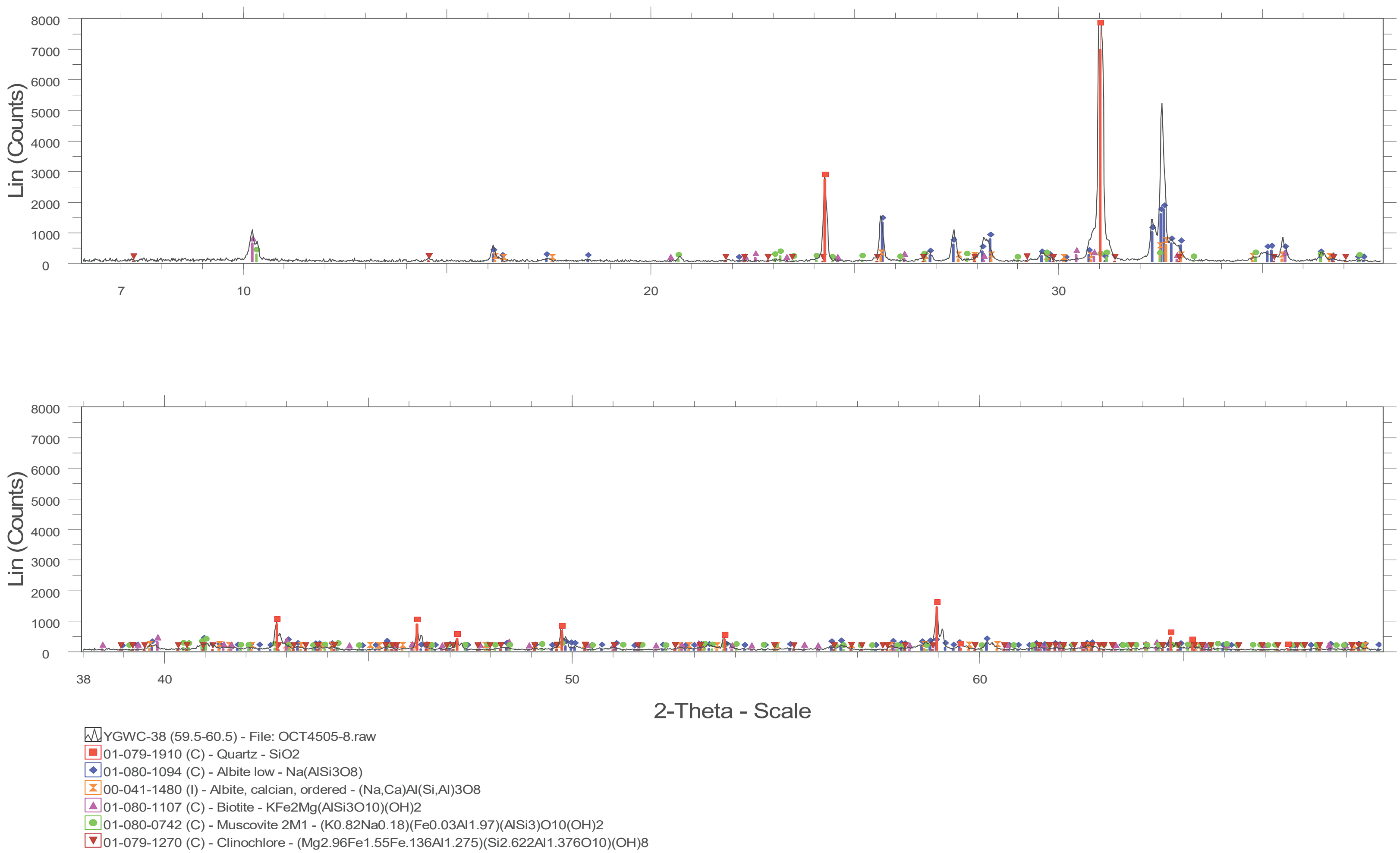
Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

YGWC-38 (39-40)



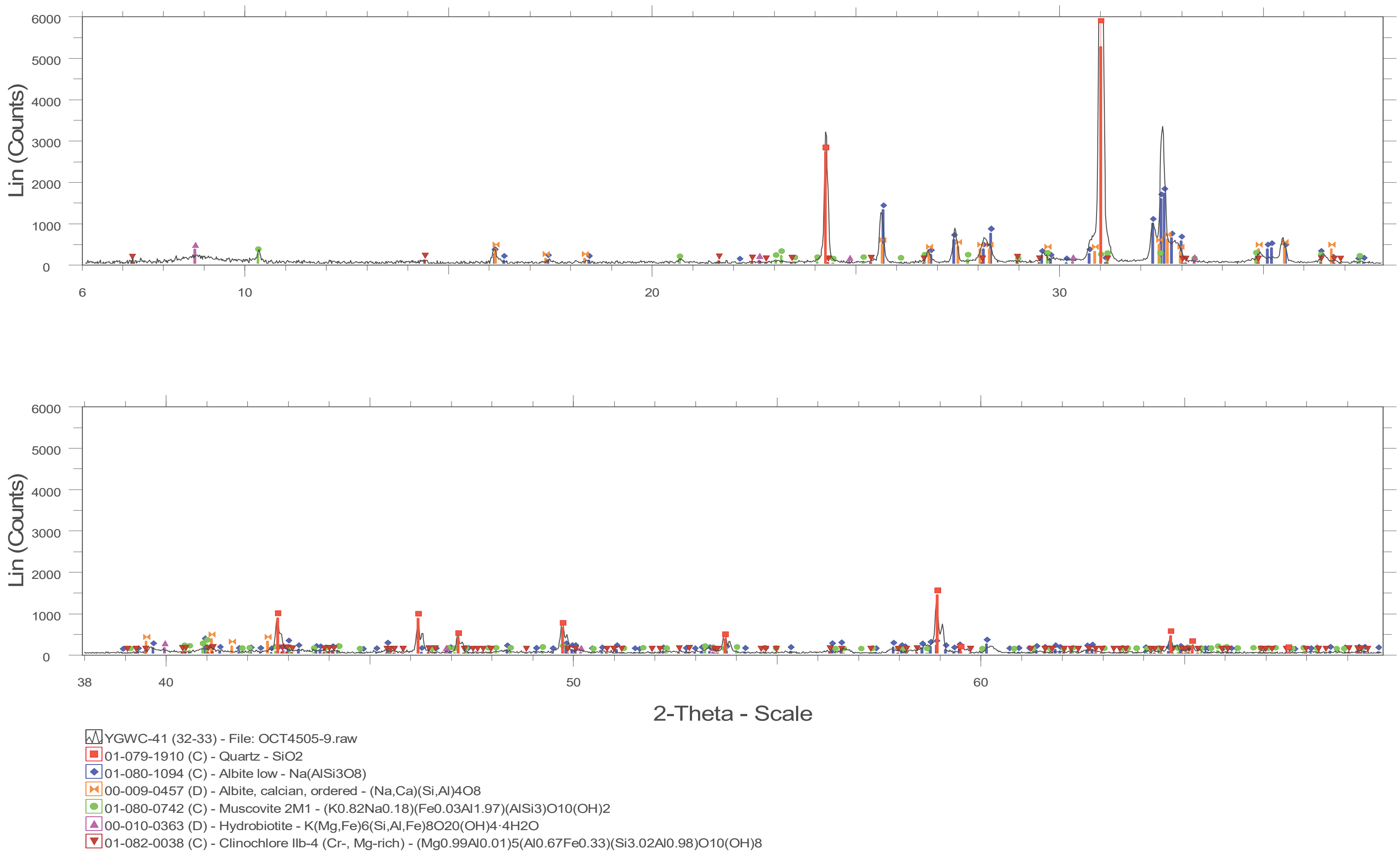
Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

YGWC-38 (59.5-60.5)



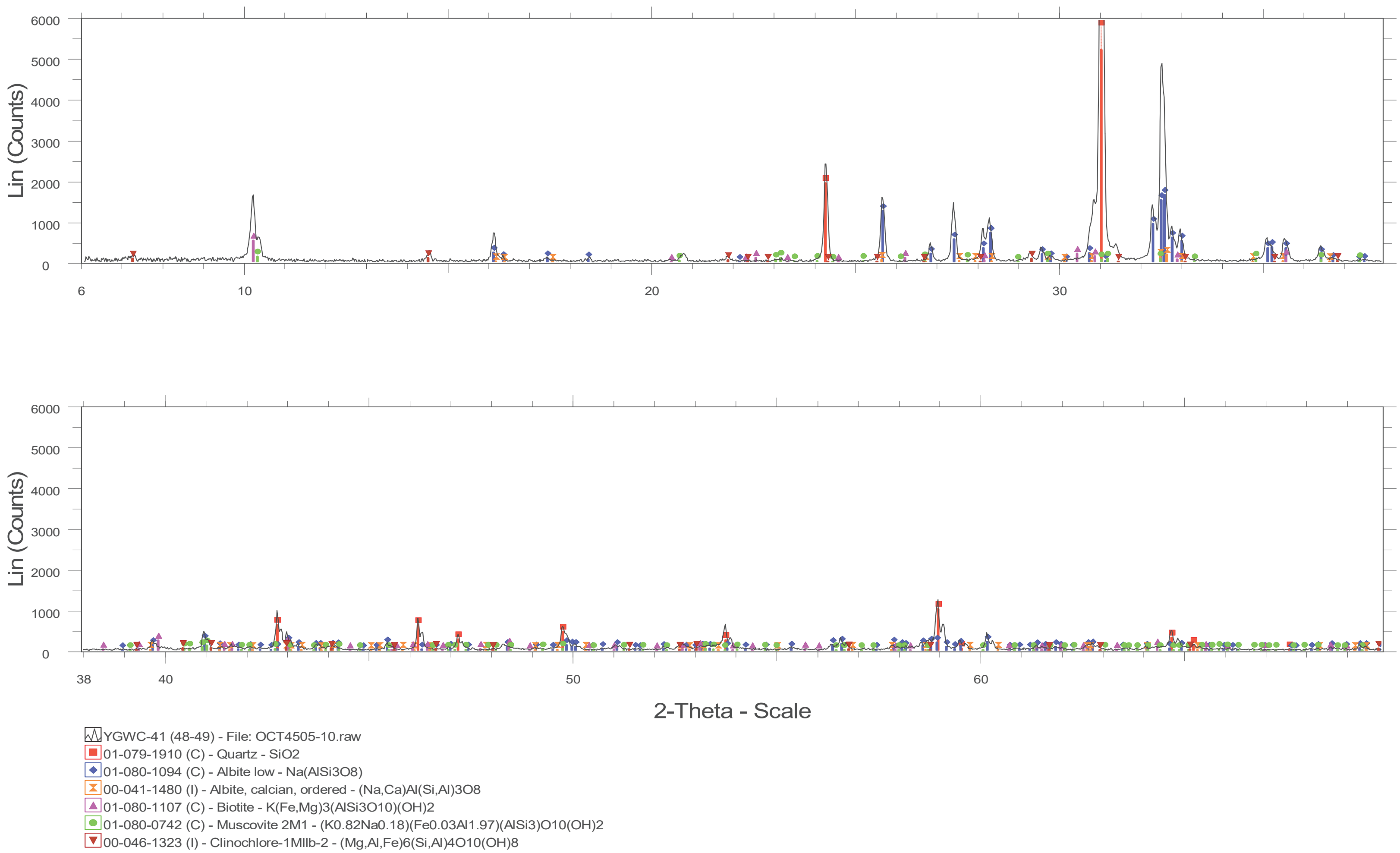
Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

YGWC-41 (32-33)



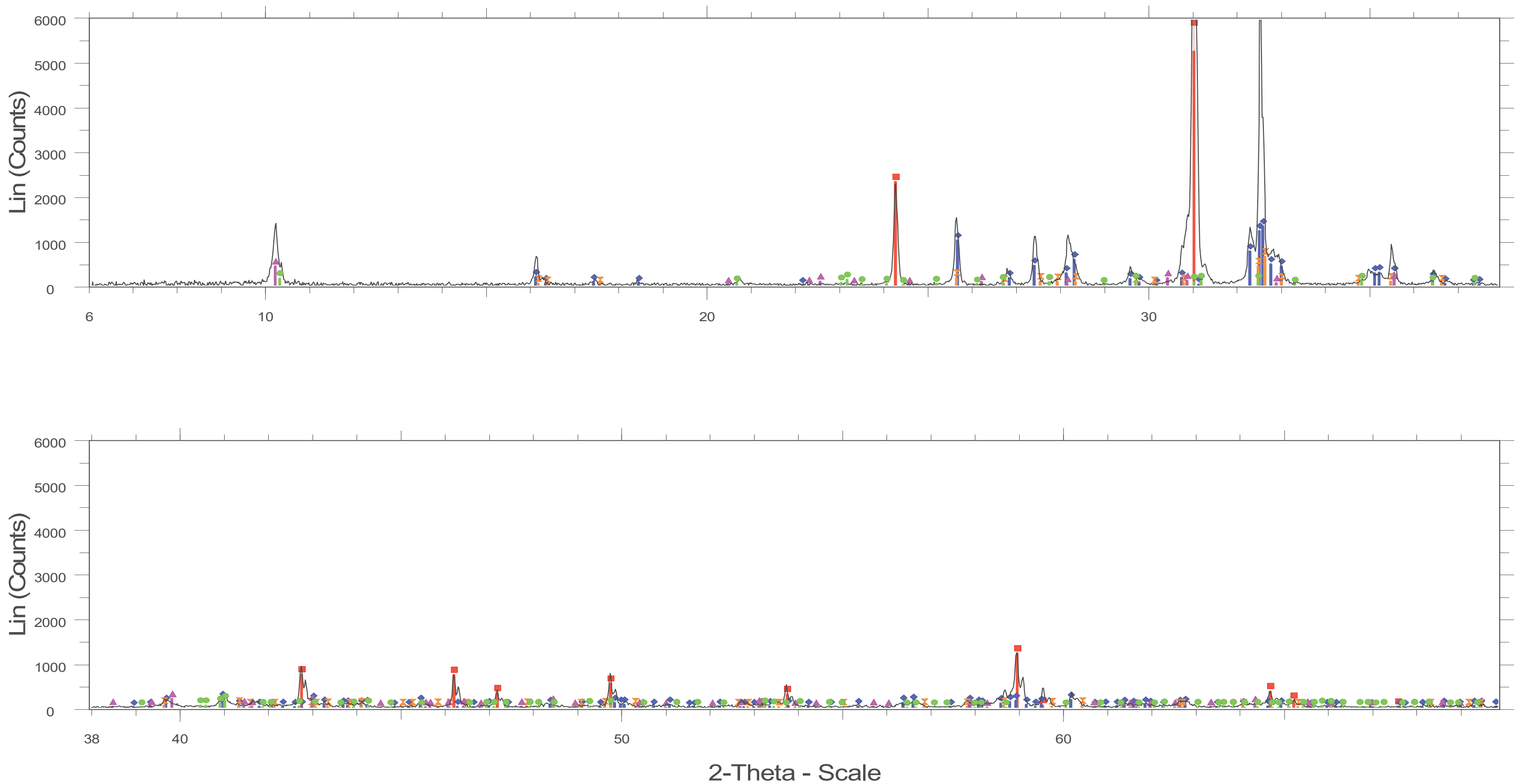
Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

YGWC-41 (48-49)



Arcadis US Inc
18122-01/MI4505-OCT20
12-Nov-20

YGWC-41 (59-60)



YGWC-41 (59-60) - File: OCT4505-11.raw
01-079-1910 (C) - Quartz - SiO2
01-080-1094 (C) - Albite low - Na(AlSi3O8)
00-041-1480 (I) - Albite, calcian, ordered - (Na,Ca)Al(Si,Al)3O8
01-080-1107 (C) - Biotite - KFe2Mg(AlSi3O10)(OH)2
01-080-0742 (C) - Muscovite 2M1 - (K0.82Na0.18)(Fe0.03Al1.97)(AlSi3)O10(OH)2

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

LR Internal Dept 14
Attn : Huyun Zhou

05-November-2020

Date Rec. : 16 October 2020
LR Report : **CA02424-OCT20**
Project : CA20I-00000-110-18122-01
Client Ref : MI4505-OCT20

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	Ag g/t	Al g/t	As g/t	Ba g/t	Be g/t	Bi g/t	Ca g/t	Cd g/t	Co g/t	Cr g/t
1: YGWC-24SA (10-44)	< 200	74100	< 200	402	< 0.8	< 8	4540	< 40	< 8	65
2: YGWC-24SA (47-49)	< 200	78200	< 200	413	< 0.8	< 8	4530	< 40	< 8	60
3: YGWC-24SA (52-54)	< 200	65700	< 200	248	< 0.8	< 8	3290	< 40	< 8	56
4: YAMW-3 (83-84)	< 200	59800	< 200	135	< 0.8	< 8	3630	< 40	< 8	157
5: YAMW-4 (88-89)	< 200	70100	< 200	90	< 0.8	< 8	4650	< 40	< 8	106
6: YGWC-38 (26-27)	< 200	63300	< 200	221	< 0.8	< 8	3440	< 40	< 8	133
7: YGWC-38 (39-40)	< 200	66600	< 200	229	< 0.8	< 8	4140	< 40	< 8	124

Sample ID	Cu g/t	Fe g/t	K g/t	Li g/t	Mg g/t	Mn g/t	Mo g/t	Ni g/t	Pb g/t	Sb g/t
1: YGWC-24SA (10-44)	< 60	15000	12200	< 100	6210	494	< 10	< 40	< 10	< 10
2: YGWC-24SA (47-49)	< 60	19800	15400	< 100	10600	865	< 10	< 40	< 10	< 10
3: YGWC-24SA (52-54)	< 60	11200	7680	< 100	5090	366	< 10	< 40	< 10	< 10
4: YAMW-3 (83-84)	< 60	9020	8740	< 100	5320	196	< 10	< 40	< 10	< 10
5: YAMW-4 (88-89)	< 60	6630	3690	< 100	4850	520	< 10	< 40	< 10	< 10
6: YGWC-38 (26-27)	< 60	10600	6390	< 100	4280	168	< 10	< 40	< 10	< 10
7: YGWC-38 (39-40)	< 60	9260	9800	< 100	4320	201	< 10	< 40	< 10	< 10

Sample ID	Se g/t	Si g/t	Sn g/t	Sr g/t	Ti g/t	Tl g/t	U g/t	V g/t	Y g/t	Zn g/t
1: YGWC-24SA (10-44)	< 200	366000	< 30	44	789	< 5	3.1	< 80	29	53
2: YGWC-24SA (47-49)	< 200	345000	< 30	46	1020	< 5	3.5	< 80	36	52
3: YGWC-24SA (52-54)	< 200	366000	< 30	54	500	< 5	2.7	< 80	38	< 50
4: YAMW-3 (83-84)	< 200	367000	< 30	47	494	< 5	2.0	< 80	29	< 50
5: YAMW-4 (88-89)	< 200	366000	< 30	63	537	< 5	2.9	< 80	40	< 50
6: YGWC-38 (26-27)	< 200	378000	< 30	41	537	< 5	2.8	< 80	57	< 50
7: YGWC-38 (39-40)	< 200	370000	< 30	60	391	< 5	3.0	< 80	46	< 50

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

LR Report : CA02424-OCT20

Sample ID	Ag g/t	Al g/t	As g/t	Ba g/t	Be g/t	Bi g/t	Ca g/t	Cd g/t	Co g/t	Cr g/t
8: YGWC-38 (59.5-60.5)	< 200	66700	< 200	294	< 0.8	< 8	6300	< 40	< 8	121
9: YGWC-41 (32-33)	< 200	61800	< 200	234	< 0.8	< 8	6700	< 40	< 8	87
10: YGWC-41 (48-49)	< 200	60100	< 200	156	< 0.8	< 8	1110	< 40	< 8	143
11: YGWC-41 (59-60)	< 200	65500	< 200	240	< 0.8	< 8	6330	< 40	< 8	99

Sample ID	Cu g/t	Fe g/t	K g/t	Li g/t	Mg g/t	Mn g/t	Mo g/t	Ni g/t	Pb g/t	Sb g/t
8: YGWC-38 (59.5-60.5)	< 60	10100	7500	< 100	2660	342	< 10	< 40	< 10	< 10
9: YGWC-41 (32-33)	< 60	15200	8240	< 100	5820	491	< 10	< 40	< 10	< 10
10: YGWC-41 (48-49)	< 60	9250	7870	< 100	6600	192	< 10	< 40	< 10	< 10
11: YGWC-41 (59-60)	< 60	9260	6540	< 100	3400	193	< 10	< 40	< 10	< 10

Sample ID	Se g/t	Si g/t	Sn g/t	Sr g/t	Ti g/t	Tl g/t	U g/t	V g/t	Y g/t	Zn g/t
8: YGWC-38 (59.5-60.5)	< 200	372000	< 30	81	553	< 5	4.0	< 80	66	< 50
9: YGWC-41 (32-33)	< 200	363000	< 30	69	789	< 5	2.5	< 80	22	< 50
10: YGWC-41 (48-49)	< 200	352000	< 30	27	489	< 5	3.3	< 80	38	< 50
11: YGWC-41 (59-60)	< 200	371000	< 30	86	582	< 5	2.6	< 80	36	< 50

Control Quality Analysis
Not suitable for commercial exchange

Sarah Thyret-Arbour

Sarah Thyret-Arbour
Technologist, Mineral Services, Analytical

OnLine LIMS

000231464

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

LR Internal Dept 14
Attn : Huyun Zhou

05-November-2020

Date Rec. : 16 October 2020
LR Report : **CA02425-OCT20**
Project : CA20I-00000-110-18122-01
Client Ref : MI4505-OCT20

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	LOI %
1: YGWC-24SA (10-44)	3.21
2: YGWC-24SA (47-49)	4.17
3: YGWC-24SA (52-54)	4.44
4: YAMW-3 (83-84)	0.90
5: YAMW-4 (88-89)	1.02
6: YGWC-38 (26-27)	2.55
7: YGWC-38 (39-40)	0.84
8: YGWC-38 (59.5-60.5)	0.78
9: YGWC-41 (32-33)	1.84
10: YGWC-41 (48-49)	0.93
11: YGWC-41 (59-60)	0.62

Control Quality Analysis
Not suitable for commercial exchange

Sarah Thyret-Arbour

Sarah Thyret-Arbour
Technologist, Mineral Services, Analytical

18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

October 20, 2020

Arcadis – Raleigh
ATTN: Jennifer Beck
5420 Wade Park Blvd #350
Raleigh, NC 27607
jennifer.beck@arcadis.com

RE: Project ARC-RA2001 Client Project: #3006037.00001

Dear Jennifer Beck,

On September 26, 2020, Brooks Applied Labs (BAL) received two (2) water samples at a temperature of 1.5°C. The samples were logged-in for the analyses of Selenium Speciation analyses, including selenite [*Se(IV)*], selenate [*Se(VI)*], selenocyanate [*SeCN*], selenomethionine [*SeMet*], methylseleninic acid [*MeSe(IV)*], selenosulfate [*SeSO3*]. Both samples were analyzed for dissolved Selenium (Se) per our phone conversation on September 29, 20020. All samples were received and stored according to BAL SOPs and EPA methodology.

Samples were field filtered.

Se Speciation Analysis by IC-ICP-CRC-MS

Each aqueous fraction submitted for Se speciation analysis was analyzed using ion chromatography inductively coupled plasma collision reaction cell mass spectrometry (IC-ICP-CRC-MS). Selenium species were chromatographically separated on an ion exchange column and then quantified using inductively coupled plasma collision reaction cell mass spectrometry (ICP-CRC-MS); for more information on this determinative technique, please visit the *Interference Reduction Technology* section on our website, brooksapplied.com.

The Se speciation results were *not* method blank corrected as described in the calculations section of the relevant BAL SOP and were evaluated using reporting limits adjusted to account for sample aliquot size. The method detection limits (MDLs) for Se(IV), Se(VI), and SeCN were generated via MDL studies. The calibration does not contain MeSe(IV), SeMet, or SeSO3 due to impurities in these standards which would bias the results for other Se species. The MDL value for Se(IV) was used as the MDL for MeSe(IV) and SeMet since Se(IV) is the nearest eluting Se species included in the calibration. The MDL value for Se(VI) was used as the MDL for SeSO3 since Se(VI) is the nearest eluting Se species included in the calibration. Please refer to the *Sample Results* page for sample-specific MDLs, method reporting limits (MRLs), and other details.

In instances where either the native sample concentration and/or the corresponding matrix duplicate (DUP) were reported as less than or equal to the MDL, and were reported as non-detectable (**ND**), the relative percent difference (RPD) between the two values was not calculated (**N/C**).

Trace Metals Quantitation by ICP-QQQ-MS

Prior to analysis all sample fractions were preserved to 1% HNO3 (v/v) and digested in a closed vessel via modified EPA Method 1638 with nitric and hydrochloric acids. Trace metals quantitation was performed using inductively coupled plasma triple quadrupole mass spectrometry (ICP-QQQ-MS). The ICP-QQQ-MS determinative method uses advanced interference removal techniques to ensure accuracy of the sample results. For more information, please visit the Interference Reduction Technology section on our website, brooksapplied.com.

In instances where the native sample result and/or the associated duplicate (DUP) result were below the MDL the RPD was not calculated (**N/C**).

In instances where a matrix spike/matrix spike duplicate (MS/MSD) set was spiked at a level less than the native sample, the recoveries are not considered valid indicators of data quality. However, these results are reported as a demonstration of precision. When the spiking levels were ≤ 25% of the native sample concentrations, the recoveries were not reported **(NR)**. No sample results were qualified on the basis of the MS or MSD recoveries

All results were *not* method blank corrected, as described in the calculations section of the relevant BAL SOPs and were evaluated using reporting limits adjusted to account for sample aliquot size.

All data was reported without further qualification, and all other associated quality control sample results met acceptance criteria.

BAL, an accredited laboratory, certifies that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page.

Please feel free to contact us if you have any questions regarding this report.

Sincerely,

Amy Goodall
Project Manager
Brooks Applied Labs
amy@brooksapplied.com

Project ID: ARC-RA2001
PM: Amy Goodall

Client PM: Jennifer Beck
Client Project: #3006037.00001

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/> or review Tables 1 and 2 in our Accreditation Information. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received
BAL	Brooks Applied Labs
BLK	method blank
BS	blank spike
CAL	calibration standard
CCB	continuing calibration blank
CCV	continuing calibration verification
COC	chain of custody record
D	dissolved fraction
DUP	duplicate
IBL	instrument blank
ICV	initial calibration verification
MDL	method detection limit
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
ND	non-detect
NR	non-reportable
N/C	not calculated
PS	post preparation spike
REC	percent recovery
RPD	relative percent difference
SCV	secondary calibration verification
SOP	standard operating procedure
SRM	reference material
T	total fraction
TR	total recoverable fraction

Definition of Data Qualifiers

(Effective 3/23/2020)

E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Please see narrative for explanation.
J	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
J-1	Estimated value. A full explanation is presented in the narrative.
M	Duplicate precision (RPD) was not within acceptance criteria. Please see narrative for explanation.
N	Spike recovery was not within acceptance criteria. Please see narrative for explanation.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.
Z	Holding time and/or preservation requirements not established for this method; however, BAL recommendations for holding time were not followed. Please see narrative for explanation.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

Accreditation Information

Table 1. Accredited method/matrix/analytes for TNI

Issued by: State of Florida Dept. of Health (The NELAC Institute 2016 Standard)
Issued on: July 27, 2020; Valid to: June 30, 2021
Certificate Number: E87982-35

Method	Matrix	TNI Accredited Analyte(s)
EPA 1638	Non-Potable Waters	Ag, Cd, Cu, Ni, Pb, Sb, Se, Tl, Zn
EPA 200.8	Non-Potable Waters	Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn
EPA 6020	Non-Potable Waters	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn
	Solids/Chemicals & Biological	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn
BAL-5000	Non-Potable Waters	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, U, V, Zn, Hardness
	Solids/Chemicals	Ag, As, B, Be, Cd, Co, Cr, Cu, Pb, Mo, Ni, Sb, Se, Sn, Sr, Tl, V, Zn
	Biological	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn
EPA 1640	Non-Potable Waters	Ag, As, Cd, Cu, Pb, Ni, Zn
EPA 1631E	Non-Potable Waters, Solids/Chemicals & Biological	Total Mercury
EPA 1630	Non-Potable Waters	Methyl Mercury
BAL-3200	Solids/Chemicals & Biological	Methyl Mercury
BAL-4100	Non-Potable Waters	As(III), As(V), DMAs, MMAs
BAL-4200	Non-Potable Waters	Se(IV), Se(VI)
BAL-4201	Non-Potable Waters	Se(IV), Se(VI)
BAL-4300	Non-Potable Waters Solid/Chemicals	Cr(VI)
SM2340B	Non-Potable Waters	Hardness

Accreditation Information

Table 2. Accredited method/matrix/analytes for ISO (1), Non-Governmental TNI (2), and DoD/DOE (3)

Issued by: ANAB

Issued on: January 10, 2020; Valid to: March 30, 2022

Method	Matrix	ISO and Non-Gov. TNI Accredited Analyte(s)	DoD/DOE Accredited Analytes
EPA 1638 Mod EPA 200.8 Mod EPA 6020 Mod BAL-5000	Non-Potable Waters	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, U, V, Zn	Ag, Al, As, Ba, Ca, Cd, Cr, Cu, Fe, Pb, Mg, Mn, Ni, Sb, Se, V, Zn
	Solids/Chemicals & Biological	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, V, Zn	Ag, As, Cd, Cr, Cu, Pb, Ni, Se, Zn
EPA 1640 Mod	Non-Potable Waters	Ag, As, Be, Cd, Cr, Co, Cu, Pb, Ni, Se, Tl, V, Zn	Not Accredited
EPA 1631E Mod BAL-3100 (waters) BAL-3101 (solids)	Non-Potable Waters, Solids/Chemicals & Biological/Food	Total Mercury	Total Mercury
EPA 1630 Mod BAL-3200	Non-Potable Waters, Solids/Chemicals Biological	Methyl Mercury	Methyl Mercury (excluding Solids/Chemicals)
EPA 1632A Mod BAL-3300	Non-Potable Waters Solids/Chemicals	Inorganic Arsenic, As(III)	Inorganic Arsenic. As(III) for waters only.
	Biological/Food	Inorganic Arsenic	Inorganic Arsenic (excluding Food)
AOAC 2015.01 Mod BAL-5000 by BAL-5040	Food	As, Cd, Hg, Pb	Not Accredited
BAL-4100	Non-Potable Waters	As(III), As(V), DMAs, MMAs	Not Accredited
	Biological by BAL-4115	Inorganic Arsenic, DMAs, MMAs	Not Accredited
BAL-4101	Food by BAL-4116	Inorganic Arsenic, DMAs, MMAs	Not Accredited
BAL-4200	Non-Potable Waters	Se(IV), Se(VI), SeCN	Not Accredited
BAL-4201	Non-Potable Waters	Se(IV), Se(VI), SeCN, SeMet	Not Accredited
BAL-4300	Non-Potable Waters, Solid/Chemicals	Cr(VI)	Cr(VI)
SM 3500-Fe BAL-4500	Non-Potable Waters	Fe, Fe(II)	Not Accredited
SM2340B	Non-Potable Waters	Hardness	Hardness
SM 2540G EPA 160.3 BAL-0501	Solids/Chemicals & Biological	% Dry Weight	% Dry Weight

(1) ISO/IEC 17025:2017 – Certificate Number ADE-1447.2
(2) Non-Governmental NELAC Institute 2016 Standard – Certificate Number ADE-1447.1
(3) Department of Defense/Energy Consolidated Quality Systems Manual v. 5.3 – Certificate Numbers ADE-1447 for DoD, ADE-1447.3 for DOE.

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
YGWC-38	2039070-01	Water	QC Sample	09/25/2020	09/26/2020
YGWC-41	2039070-02	Water	Sample	09/25/2020	09/26/2020

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
MeSe(IV)	Water	SOP BAL-4200	09/29/2020	09/30/2020	B202612	2001183
Se	Water	EPA 1638 Mod	10/12/2020	10/14/2020	B202717	2001231
Se(IV)	Water	SOP BAL-4200	09/29/2020	09/30/2020	B202612	2001183
Se(VI)	Water	SOP BAL-4200	09/29/2020	09/30/2020	B202612	2001183
SeCN	Water	SOP BAL-4200	09/29/2020	09/30/2020	B202612	2001183
SeMet	Water	SOP BAL-4200	09/29/2020	09/30/2020	B202612	2001183
SeSO3	Water	SOP BAL-4200	09/29/2020	09/30/2020	B202612	2001183

Project ID: ARC-RA2001
PM: Amy Goodall

Client PM: Jennifer Beck
Client Project: #3006037.00001

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
YGWC-38										
2039070-01	MeSe(IV)	Water	D	≤ 0.350	U	0.350	1.25	µg/L	B202612	2001183
2039070-01	Se	Water	D	85.9		0.018	0.057	µg/L	B202717	2001231
2039070-01	Se(IV)	Water	D	≤ 0.350	U	0.350	1.25	µg/L	B202612	2001183
2039070-01	Se(VI)	Water	D	82.1		0.300	1.25	µg/L	B202612	2001183
2039070-01	SeCN	Water	D	≤ 0.250	U	0.250	1.25	µg/L	B202612	2001183
2039070-01	SeMet	Water	D	≤ 0.350	U	0.350	1.25	µg/L	B202612	2001183
2039070-01	SeSO3	Water	D	≤ 0.300	U	0.300	1.25	µg/L	B202612	2001183
YGWC-41										
2039070-02	MeSe(IV)	Water	D	≤ 0.350	U	0.350	1.25	µg/L	B202612	2001183
2039070-02	Se	Water	D	50.7		0.018	0.057	µg/L	B202717	2001231
2039070-02	Se(IV)	Water	D	≤ 0.350	U	0.350	1.25	µg/L	B202612	2001183
2039070-02	Se(VI)	Water	D	49.3		0.300	1.25	µg/L	B202612	2001183
2039070-02	SeCN	Water	D	≤ 0.250	U	0.250	1.25	µg/L	B202612	2001183
2039070-02	SeMet	Water	D	≤ 0.350	U	0.350	1.25	µg/L	B202612	2001183
2039070-02	SeSO3	Water	D	≤ 0.300	U	0.300	1.25	µg/L	B202612	2001183

Accuracy & Precision Summary

Batch: B202612
Lab Matrix: Water
Method: SOP BAL-4200

Sample	Analyte	Native	Spike	Result	Units	REC	& Limits	RPD	& Limits
B202612-BS1	**Blank Spike, (1923027)**								
	MeSe(IV)		5.095	4.780	µg/L	94%	75-125		
	Se(IV)		5.000	5.097	µg/L	102%	75-125		
	Se(VI)		5.000	5.024	µg/L	100%	75-125		
	SeCN		5.015	4.984	µg/L	99%	75-125		
	SeMet		4.932	4.863	µg/L	99%	75-125		
B202612-DUP2	**Duplicate, (2039070-01)**								
	MeSe(IV)	ND		ND	µg/L			N/C	25
	Se(IV)	ND		ND	µg/L			N/C	25
	Se(VI)	82.12		81.15	µg/L			1%	25
	SeCN	ND		ND	µg/L			N/C	25
	SeMet	ND		ND	µg/L			N/C	25
	SeSO3	ND		ND	µg/L			N/C	25
B202612-MS2	**Matrix Spike, (2039070-01)**								
	Se(IV)	ND	245.0	256.0	µg/L	104%	75-125		
	Se(VI)	82.12	255.0	344.8	µg/L	103%	75-125		
	SeCN	ND	245.2	250.1	µg/L	102%	75-125		
	SeMet	ND	49.42	43.25	µg/L	88%	75-125		
B202612-MSD2	**Matrix Spike Duplicate, (2039070-01)**								
	Se(IV)	ND	245.0	257.3	µg/L	105%	75-125	0.5%	25
	Se(VI)	82.12	255.0	344.4	µg/L	103%	75-125	0.1%	25
	SeCN	ND	245.2	248.1	µg/L	101%	75-125	0.8%	25
	SeMet	ND	49.42	42.64	µg/L	86%	75-125	1%	25

Accuracy & Precision Summary

Batch: B202717
Lab Matrix: Water
Method: EPA 1638 Mod

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits	
B202717-BS1	**Blank Spike, (2042013)**								
	Se		20.00	20.66	µg/L	103%	75-125		
B202717-BS2	**Blank Spike, (2042013)**								
	Se		20.00	20.85	µg/L	104%	75-125		
B202717-BS3	**Blank Spike, (2042013)**								
	Se		20.00	21.00	µg/L	105%	75-125		
B202717-DUP4	**Duplicate, (2039070-01)**								
	Se	85.87		86.49	µg/L			0.7%	20
B202717-MS4	**Matrix Spike, (2039070-01)**								
	Se	85.87	10.20	96.60	µg/L	NR	75-125		
B202717-MSD4	**Matrix Spike Duplicate, (2039070-01)**								
	Se	85.87	10.20	94.98	µg/L	NR	75-125	N/C	20

Method Blanks & Reporting Limits

Batch: B202612
Matrix: Water
Method: SOP BAL-4200
Analyte: MeSe(IV)

Sample	Result	Units
B202612-BLK1	0.00	µg/L
B202612-BLK2	0.00	µg/L
B202612-BLK3	0.00	µg/L
B202612-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.007
Limit: 0.025 **MRL:** 0.025

Analyte: Se(IV)

Sample	Result	Units
B202612-BLK1	0.00	µg/L
B202612-BLK2	0.00	µg/L
B202612-BLK3	0.00	µg/L
B202612-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.007
Limit: 0.025 **MRL:** 0.025

Analyte: Se(VI)

Sample	Result	Units
B202612-BLK1	0.00	µg/L
B202612-BLK2	0.00	µg/L
B202612-BLK3	0.00	µg/L
B202612-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.006
Limit: 0.025 **MRL:** 0.025

Method Blanks & Reporting Limits

Analyte: SeCN

Sample	Result	Units
B202612-BLK1	0.00	µg/L
B202612-BLK2	0.00	µg/L
B202612-BLK3	0.00	µg/L
B202612-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.005
Limit: 0.025 **MRL:** 0.025

Analyte: SeMet

Sample	Result	Units
B202612-BLK1	0.00	µg/L
B202612-BLK2	0.00	µg/L
B202612-BLK3	0.00	µg/L
B202612-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.007
Limit: 0.025 **MRL:** 0.025

Analyte: SeSO3

Sample	Result	Units
B202612-BLK1	0.00	µg/L
B202612-BLK2	0.00	µg/L
B202612-BLK3	0.00	µg/L
B202612-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.006
Limit: 0.025 **MRL:** 0.025

Project ID: ARC-RA2001
PM: Amy Goodall

Client PM: Jennifer Beck
Client Project: #3006037.00001

Method Blanks & Reporting Limits

Batch: B202717
Matrix: Water
Method: EPA 1638 Mod
Analyte: Se

Sample	Result	Units
B202717-BLK1	0.009	µg/L
B202717-BLK2	0.006	µg/L
B202717-BLK3	0.005	µg/L
B202717-BLK4	0.005	µg/L

Average: 0.006
Limit: 0.056

MDL: 0.018
MRL: 0.056

Sample Containers

Lab ID: 2039070-01
Sample: YGWC-38
Report Matrix: Water
Sample Type: QC Sample
Collected: 09/25/2020
Received: 09/26/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	10 mL	na	none	na	na	Cooler 1 - 2039070
B	XTRA_VOL	250 mL	na	none	na	na	Cooler 1 - 2039070
C	Cent Tube 50mL	50 mL	na	0.2% HNO3 (BAL)	202437	2	Cooler 1 - 2039070

Lab ID: 2039070-02
Sample: YGWC-41
Report Matrix: Water
Sample Type: Sample
Collected: 09/25/2020
Received: 09/26/2020

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL Se-Sp	10 mL	na	none	na	na	Cooler 1 - 2039070
B	XTRA_VOL	250 mL	na	none	na	na	Cooler 1 - 2039070
C	Cent Tube 50mL	50 mL	na	0.2% HNO3 (BAL)	2024037	2	Cooler 1 - 2039070

Shipping Containers

Cooler 1 - 2039070

Received: September 26, 2020 9:15
Tracking No: 3972 1768 2270 via FedEx
Coolant Type: Ice
Temperature: 1.5 °C

Description: Cooler 1
Damaged in transit? No
Returned to client? No
Comments: IR 21

Custody seals present? Yes
Custody seals intact? Yes
COC present? Yes

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BROOKS LAB

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page : 1 Of 1

Section A
Required Client Information:

Company:	Georgia Power
Address:	1070 Bridge Mill Ave
	Canton, GA 30114
Email:	
Phone:	(770)384-6526
Fax:	
Requested Due Date:	

Section B
Required Project Information:

Report To:	Becky Steever
Copy To:	
Purchase Order #:	
Project Name:	~~Yates R6~~ AMX
Project #:	

Section C
Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote:	
Pace Project Manager:	~~kevin.herring@pacelabs.com,~~
Pace Profile #:	~~10040~~

Regulatory Agency	
State / Location	GA

MATRIX / CODE: Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Other OT; Tissue TS

SAMPLE ID — One Character per box. (A-Z, 0-9 / , -) Sample Ids must be unique

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED START DATE	START TIME	END DATE	END TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Other	Analyses Test Y/N	~~TDS~~	~~Anions~~	~~App III & IV Metals~~	~~App III & IV Hg~~	~~RAD 9315/9320~~	Se Species	Residual Chlorine (Y/N)
13	~~PZ-37~~	~~WT~~																	~~x~~	~~x~~		~~X~~	~~X~~		
14	YGWC-38			9/25	0940				1	X														1	
15	YGWC-41			9/25	1335				1	X														1	
16																									
17																									
18																									
19																									
20																									
21																									
22																									
23																									
24																									

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
Se(IV), Se(VI), SeCN unknown 250 mL plastic	Arcadis	9/25/20	1600	[signature]	9/26/20	9:15	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Michael Guy

SIGNATURE of SAMPLER: [signature] DATE Signed: 9/25/20

TEMP in C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

BROOKS APPLIED LABS
18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

May 10, 2022

Pace Analytical Services - Huntersville
ATTN: Nicole D'Oleo
9800 Kincey Ave., Suite 100
Huntersville, NC, 28078
nicole.d'oleo@pacelabs.com

RE: Project PAC-HN2006 Client Project: 92597863

Dear Nicole D'Oleo,

Brooks Applied Labs (BAL) received one (1) water sample on April 30, 2022. The shipping container's temperature was within our recommended range at 5.4°C. The samples were logged-in for the analyses of Selenium Speciation (Se (IV), Se (VI), SeCN, MeSe(IV), SeMet, $SeSO_3$, DMSeO, and unknown Se species) according to the chain-of-custody (COC) form. All samples were received and stored according to BAL SOPs and EPA methodology.

Sample *PZ-37* (2204372-01) was field filtered.

<u>Selenium Speciation Quantitation by IC-ICP-CRC-MS</u>
The selenium speciation analysis was performed by ion chromatography coupled to an inductively coupled plasma collision reaction cell mass spectrometer (IC-ICP-CRC-MS). Prior to analysis, an aliquot of each sample was filtered with a syringe filter (0.45-µm) and injected directly into a sealed autosampler vial. No further sample preparation was performed as any chemical alteration of a sample may shift the equilibrium of the system, resulting in changes in speciation ratios.

The "Unk Sp Count" is the number of unknown species for a sample in the chromatogram.

In instances where the native sample result and/or the associated duplicate (DUP) result were below the MDL the RPD was not calculated (**N/C**).

The results were not method blank corrected as described in the calculations section of the relevant BAL SOP(s) and were evaluated using reporting limits adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details.

Aside from concentration qualifiers, all data was reported without qualification and all associated quality control sample results met the acceptance criteria.

BAL, an accredited laboratory, certifies that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page in your report. This report should be used in its entirety for interpretation of results.

Please feel free to contact us if you have any questions regarding this report.

Sincerely,

Amy Goodall
Project Manager
Brooks Applied Labs
amy@brooksapplied.com

Project ID: PAC-HN2006
PM: Amy Goodall

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations /certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/> or review Tables 1 and 2 in our Accreditation Information. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BLK	method blank	**ND**	non-detect
BS	blank spike	**NR**	non-reportable
CAL	calibration standard	**N/C**	not calculated
CCB	continuing calibration blank	**PS**	post preparation spike
CCV	continuing calibration verification	**REC**	percent recovery
COC	chain of custody record	**RPD**	relative percent difference
D	dissolved fraction	**SCV**	secondary calibration verification
DUP	duplicate	**SOP**	standard operating procedure
IBL	instrument blank	**SRM**	reference material
ICV	initial calibration verification	**T**	total fraction
MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

(Effective 3/23/2020)

E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Please see narrative for explanation.
J	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
J-1	Estimated value. A full explanation is presented in the narrative.
M	Duplicate precision (RPD) was not within acceptance criteria. Please see narrative for explanation.
N	Spike recovery was not within acceptance criteria. Please see narrative for explanation.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.
Z	Holding time and/or preservation requirements not established for this method; however, BAL recommendations for holding time were not followed. Please see narrative for explanation.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

18804 North Creek Parkway, Suite 100, Bothell, WA 98011 · P(206) 632-6206 · F(206) 632-6017 · info@brooksapplied.com · www.brooksapplied.com

Accreditation Information

Table 1. Accredited method/matrix/analytes for TNI

Issued by: State of Florida Dept. of Health (The NELAC Institute 2016 Standard)
Issued on: July 1, 2021; Valid to: June 30, 2022
Certificate Number: E87982-37

Method	Matrix	TNI Accredited Analyte(s)
EPA 1638	Non-Potable Waters	Ag, Cd, Cu, Ni, Pb, Sb, Se, Tl, Zn
EPA 200.8	Non-Potable Waters	Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn
EPA 6020	Non-Potable Waters	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn
	Solids/Chemicals & Biological	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn
BAL-5000	Non-Potable Waters	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, U, V, Zn, Hardness
	Solids/Chemicals	Ag, As, B, Be, Cd, Co, Cr, Cu, Pb, Mo, Ni, Sb, Se, Sn, Sr, Tl, V, Zn
	Biological	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn
EPA 1640	Non-Potable Waters	Cd, Cu, Pb, Ni, Zn
EPA 1631E	Non-Potable Waters, Solids/Chemicals & Biological	Total Mercury
EPA 1630	Non-Potable Waters	Methyl Mercury
BAL-3200	Solids/Chemicals & Biological	Methyl Mercury
BAL-4100	Non-Potable Waters	As(III), As(V), DMAs, MMAs
BAL-4201	Non-Potable Waters	Se(IV), Se(VI)
BAL-4300	Non-Potable Waters Solid/Chemicals	Cr(VI)
SM2340B	Non-Potable Waters	Hardness

Accreditation Information

Table 2. Accredited method/matrix/analytes for ISO (1), Non-Governmental TNI (2)

Issued by: ANAB

Issued on: September 21, 2021; Valid to: March 30, 2024

Method	Matrix	ISO and Non-Gov. TNI Accredited Analyte(s)
EPA 1638 Mod EPA 200.8 Mod EPA 6020 Mod BAL-5000	Non-Potable Waters	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, U, V, Zn
	Solids/Chemicals & Biological	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, V, Zn Hg (Biological Only)
EPA 1640 Mod	Non-Potable Waters	Cd, Cu, Pb, Ni, Zn Ag, As, Cr, Co, Se, Tl, V (ISO Only)
EPA 1631E Mod BAL-3100	Non-Potable Waters, Solids/Chemicals & Biological/Food	Total Mercury
EPA 1630 Mod BAL-3200	Non-Potable Waters, Solids/Chemicals Biological	Methyl Mercury
EPA 1632A Mod BAL-3300	Non-Potable Waters	Inorganic Arsenic (ISO Only)
	Biological/Food Solids/Chemicals	Inorganic Arsenic (ISO Only)
AOAC 2015.01 Mod BAL-5000	Food	As, Cd, Hg, Pb
BAL-4100	Non-Potable Waters	As(III), As(V), DMAs, MMAs
	Biological by BAL-4117	Inorganic Arsenic, DMAs, MMAs (ISO Only)
BAL-4101	Food by BAL-4117	Inorganic Arsenic, DMAs, MMAs (ISO Only)
BAL-4201	Non-Potable Waters	Se(IV), Se(VI), SeCN, SeMet
BAL-4300	Non-Potable Waters, Solid/Chemicals	Cr(VI)
SM 3500-Fe BAL-4500	Non-Potable Waters	Fe, Fe(II) (ISO Only)
SM2340B	Non-Potable Waters	Hardness
SM 2540G BAL-0501	Solids/Chemicals & Biological	% Dry Weight

Sample Information

Sample	Alias	Lab ID	Report Matrix	Type	Sampled	Received
PZ-37	92597863005	2204372-01	Water	Sample	04/07/2022	04/30/2022

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
DMSeO	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506
MeSe(IV)	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506
Se(IV)	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506
Se(VI)	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506
SeCN	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506
SeMet	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506
SeSO3	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506
Unk Se Sp	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506
Unk Sp Count	Water	SOP BAL-4201	05/04/2022	05/04/2022	B220962	S220506

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
PZ-37, 92597863005										
2204372-01	DMSeO	Water	D	≤ 2.00	U	2.00	5.00	µg/L	B220962	S220506
2204372-01	MeSe(IV)	Water	D	≤ 2.00	U	2.00	5.00	µg/L	B220962	S220506
2204372-01	Se(IV)	Water	D	4.79	J	2.00	15.0	µg/L	B220962	S220506
2204372-01	Se(VI)	Water	D	188		2.00	11.0	µg/L	B220962	S220506
2204372-01	SeCN	Water	D	≤ 2.00	U	2.00	10.0	µg/L	B220962	S220506
2204372-01	SeMet	Water	D	≤ 2.00	U	2.00	5.00	µg/L	B220962	S220506
2204372-01	SeSO3	Water	D	≤ 2.00	U	2.00	11.0	µg/L	B220962	S220506
2204372-01	Unk Se Sp	Water	D	≤ 2.00	U	2.00	15.0	µg/L	B220962	S220506
2204372-01	Unk Sp Count	Water	D	0	U			count	B220962	S220506

Accuracy & Precision Summary

Batch: B220962
Lab Matrix: Water
Method: SOP BAL-4201

Sample	Analyte	Native	Spike	Result	Units	REC	Limits	RPD	Limits
B220962-BS1	**Blank Spike, (2124033)**								
	MeSe(IV)		5.095	5.286	µg/L	104%	75-125		
	Se(IV)		5.000	5.003	µg/L	100%	75-125		
	Se(VI)		5.000	4.938	µg/L	99%	75-125		
	SeCN		5.015	4.872	µg/L	97%	75-125		
	SeMet		4.932	4.792	µg/L	97%	75-125		
B220962-DUP2	**Duplicate, (2205017-04)**								
	DMSeO	ND		ND	µg/L			N/C	25
	MeSe(IV)	ND		ND	µg/L			N/C	25
	Se(IV)	67.37		66.35	µg/L			2%	25
	Se(VI)	ND		ND	µg/L			N/C	25
	SeCN	ND		ND	µg/L			N/C	25
	SeMet	ND		ND	µg/L			N/C	25
	SeSO3	ND		ND	µg/L			N/C	25
	Unk Se Sp	ND		ND	µg/L			N/C	25
	Unk Sp Count	0		0	count				200
B220962-MS2	**Matrix Spike, (2205017-04)**								
	Se(IV)	67.37	49.00	112.9	µg/L	93%	75-125		
	Se(VI)	ND	51.00	47.64	µg/L	93%	75-125		
	SeCN	ND	19.62	16.91	µg/L	86%	75-125		
	SeMet	ND	19.77	17.35	µg/L	88%	75-125		
B220962-MSD2	**Matrix Spike Duplicate, (2205017-04)**								
	Se(IV)	67.37	49.00	112.4	µg/L	92%	75-125	0.5%	25
	Se(VI)	ND	51.00	46.73	µg/L	92%	75-125	2%	25
	SeCN	ND	19.62	17.21	µg/L	88%	75-125	2%	25
	SeMet	ND	19.77	16.85	µg/L	85%	75-125	3%	25

Method Blanks & Reporting Limits

Batch: B220962
Matrix: Water
Method: SOP BAL-4201
Analyte: DMSeO

Sample	Result	Units
B220962-BLK1	0.00	µg/L
B220962-BLK2	0.00	µg/L
B220962-BLK3	0.00	µg/L
B220962-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.005 **MRL:** 0.005

Analyte: MeSe(IV)

Sample	Result	Units
B220962-BLK1	0.00	µg/L
B220962-BLK2	0.00	µg/L
B220962-BLK3	0.00	µg/L
B220962-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.005 **MRL:** 0.005

Analyte: Se(IV)

Sample	Result	Units
B220962-BLK1	0.00	µg/L
B220962-BLK2	0.00	µg/L
B220962-BLK3	0.00	µg/L
B220962-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.015 **MRL:** 0.015

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Project ID: PAC-HN2006
PM: Amy Goodall

Client PM: Nicole D'Oleo
Client Project: 92597863

Method Blanks & Reporting Limits

Analyte: Se(VI)

Sample	Result	Units
B220962-BLK1	0.00	µg/L
B220962-BLK2	0.00	µg/L
B220962-BLK3	0.00	µg/L
B220962-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.011 **MRL:** 0.011

Analyte: SeCN

Sample	Result	Units
B220962-BLK1	0.00	µg/L
B220962-BLK2	0.00	µg/L
B220962-BLK3	0.00	µg/L
B220962-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.010 **MRL:** 0.010

Analyte: SeMet

Sample	Result	Units
B220962-BLK1	0.00	µg/L
B220962-BLK2	0.00	µg/L
B220962-BLK3	0.00	µg/L
B220962-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.005 **MRL:** 0.005

Analyte: SeSO3

Sample	Result	Units
B220962-BLK1	0.00	µg/L
B220962-BLK2	0.00	µg/L
B220962-BLK3	0.00	µg/L
B220962-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.011 **MRL:** 0.011

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Method Blanks & Reporting Limits

Analyte: Unk Se Sp

Sample	Result	Units
B220962-BLK1	0.00	µg/L
B220962-BLK2	0.00	µg/L
B220962-BLK3	0.00	µg/L
B220962-BLK4	0.00	µg/L

Average: 0.000 **MDL:** 0.002
Limit: 0.015 **MRL:** 0.015

Analyte: Unk Sp Count

Sample	Result	Units
B220962-BLK1	0	count
B220962-BLK2	0	count
B220962-BLK3	0	count
B220962-BLK4	0	count

MRL:

Sample Containers

Lab ID: 2204372-01
Sample: PZ-37
Report Matrix: Water
Sample Type: Sample + Sum
Collected: 04/07/2022
Received: 04/30/2022

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Cent Tube 15mL	15 mL	NA	NONE	NA	NA	Cooler - 2204372
B	XTRA_VOL	60 mL	NA	NONE	NA	NA	Cooler - 2204372

Shipping Containers

Cooler - 2204372

Received: April 30, 2022 8:56
Tracking No: 5041 9000 2698 via FedEx
Coolant Type: Ice
Temperature: 5.4 °C

Description: Cooler
Damaged in transit? No
Returned to client? No
Comments: IR#: 33

Custody seals present? No
Custody seals intact? No
COC present? Yes

Chain of Custody

PASI Charlotte Laboratory

Pace Analytical®
www.pacelabs.com

Workorder: 92597863 **Workorder Name:** YATES AEM

Results Requested By: 4/21/2022

Report / Invoice To

Nicole D'Oleo
Pace Analytical Charlotte
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
Phone (704)875-9092
Email: nicole.d'oleo@pacelabs.com

State of Sample Origin: GA

Subcontract To

P.O. NGD92597863

Brooks Applied Labs
18804 North Creek Parkway
Suite 100
Bothell, WA 98011

Requested Analysis

Item	Sample ID	Collect Date/Time	Lab ID	Matrix	Unpreserved	Se Speciation	LAB USE ONLY
1	PZ-37	4/7/2022 12:00	92597863005	Water	1	X	
2							
3							
4							
5							

Transfers	Released By	Date/Time	Received By	Date/Time
1	Charles Hale	4/29/22 1700	FedEx	
2			[illegible]	4/30/22 8:56
3				

Cooler Temperature on Receipt ____ °C | Custody Seal Y or N | Received on Ice Y or N | Samples Intact Y or N

DMSeO, MeSe(IV), Se(IV), Se(VI), SeCN, SeMet, SeSO3, Unknown Se Species, Unknown Species Count

Appendix C

Groundwater Flow and Transport Model

Appendix C

Transport Model Report

Plant Yates

Newnan, Georgia

08/26/2022

Plant Yates Transport Model Report

Plat Yates

Newnan, Georgia

08/26/2022

Prepared By:
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Contents

Tables

Figures

Acronyms and Abbreviations

ACM	assessment of corrective measures
AMA	ash management area
AP	Ash Pond
AP-3	Ash Pond 3
AP-A	Ash Pond A
AP-B	Ash Pond B
AP-B’	Ash Pond B’
Arcadis	Arcadis U.S., Inc.
BCT	Block-Centered Transport
bgs	below ground surface
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
CLN	connected linear network
cm/sec	centimeter per second
ET	evapotranspiration
°F	degrees Fahrenheit
ft^2/d	square foot per day
GA EPD	Georgia Environmental Protection Division
gpm	gallon per minute
GWF	groundwater flow
GWPS	Groundwater Protection Standards
in/yr	inch per year
L/kg	liter per kilogram
MDL	method detection limit
mg/kg	milligram per kilogram
mg/L	milligram per liter
MNA	monitored natural attenuation
msl	mean sea level
MTC	mass transfer coefficient

NAVD88	North American Vertical Datum of 1988
PWR	Partially Weathered Rock
SCS	Southern Company Services
SSL	statistically significant level
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
ZVI	zero-valent iron

Executive Summary

This report documents the groundwater transport model developed to support remedy selection for selenium detected at statistically significant levels (SSL) above groundwater protection standards (GWPS) in compliance wells YGWC-38 and PZ-37 at Plant Yates AP-3, 3, B, B' and R6 CCR Landfill (the Site).The groundwater transport model was used to evaluate the corrective measures proposed in the Remedy Selection Report (Arcadis, 2022a) and to estimate the timeframe by which the GWPS can be met at the waste boundary compliance wells for each of the proposed remedial alternatives. The model is designed to simulate historical average flow conditions and the fate and transport of selenium from historical periods through post-closure near the R6 CCR Landfill. The transport model construction and parameter initialization are based on the existing geochemical conceptual site model (CSM; Arcadis 2022a, Appendix B).

The simulation of the fate and transport of selenium in the groundwater transport model is based on the three-dimensional groundwater flow model developed using MODFLOW-USG transport (USGT [Panday 2020]). Selenium transport was modeled from 1978 to 2020 to match the measured selenium concentration near the R6 CCR Landfill. The calibration results indicate a satisfactory match between observed and simulated selenium concentrations, which indicates that the transport model is a robust tool for simulation of future selenium migration and for evaluation of the effectiveness of various remedial alternatives at the R6 CCR Landfill and AMA at Plant Yates. The overall modeling approach includes parameterization, calibration and verification process employed by Arcadis for this study (and in general) is in accordance with the GA EPD's guidance on groundwater contaminant fate and transport modeling (GA EPD, 2016).

The primary objective of the transport model is to simulate the fate and transport of selenium under the proposed corrective measure alternatives being evaluated for groundwater remedy selection. The predictive transport model was developed to represent a post-closure period of 30 years. The predictive transport model incorporated relevant closure activities that hydraulically impact groundwater flow and transport at the Site (i.e., Engineering Measure drain and cover installation). Details of closure activities are described in the Remedy Selection Report (Arcadis 2022a) and Semiannual Groundwater Monitoring and Corrective Action Report (Arcadis 2022b). Note that this transport model report is included as an appendix to the remedy selection report (Arcadis 2020a). Based on the remedy selection process, Arcadis has identified two corrective measures as potentially applicable to remediate groundwater at the Site and were evaluated with the predictive transport model as corrective measures alternatives:

1. Monitored Natural Attenuation [MNA] and

2. Geochemical Manipulation via In-Situ Injections.

The findings from this transport modeling indicate that the Engineering Measure drain is an effective control measure for capturing groundwater under and reducing the saturation footprint of CCR materials at the R6 CCR Landfill and AMA. As groundwater levels decline, the pumping rate of the Engineering Measure drain exponentially declines and eventually reaches a near steady-state condition within 10 to 15 years of active pumping operation. The transport simulations suggest the GWPS can be attained at the R6 CCR Landfill boundary within about 10 years with either Alternative 1 or Alternative 2.

Introduction

Georgia Power Company operates a natural gas-fired station at Plant Yates approximately 8 miles northwest of Newnan, Coweta County, Georgia. There are currently several inactive ash-related units at Plant Yates that are being closed in accordance with state and federal regulations; namely, the Georgia Environmental Protection Division (GA EPD) Rules of Solid Waste Management 391-3-4-.10 and the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Rule 40 Code of Federal Regulations (CFR) 257 Subpart D. The coal ash impoundments that are subject to the CCR Rule are shown on **Figure 1**. CCR placement in AP-3, AP-A, AP-B, and AP-B' ceased in 2014. Closure activities were initiated on December 7, 2015 (AP-A) and April 20, 2018 (AP-B, AP-B', and AP-3). AP-B' and AP-3 are being closed in place. AP-A and AP-B are being closed by removal with consolidation of CCR from those impoundments placed in AP-B' and AP-3, which make up the footprint of the Ash Management Area (AMA). CCR placement in the R6 CCR Landfill ceased in October 2015. The R6 CCR Landfill is being closed in place and covered in accordance with the closure plan. Due to the configuration of the units and overall groundwater flow direction, the monitoring systems of AP-3, A, B, and B' and the R6 CCR Landfill were combined into a single multi-unit monitoring system that meets federal and state monitoring requirements. These units will be referred as AMA-R6 (the Site) herein after in this report.

Georgia Power has completed a detailed evaluation of corrective measures to address selenium in groundwater at statistically significant levels (SSLs) above the Groundwater Protection Standards (GWPS) at monitoring wells YGWC-38 and PZ-37[1]. An evaluation of potential corrective measures to address selenium in groundwater is presented in the remedy selection report (Arcadis, 2022a). The groundwater transport model simulates CCR pond closure methods and two potential corrective measures alternatives (MNA and In-Situ Injections) being evaluated in the Draft Remedy Selection Report. This transport model report summarizes the details of the transport model development, calibration, and assessment of predictive simulation of the two potential corrective measures alternatives.

Background

Information relevant to the transport model includes location, geology, geochemical environment, groundwater flow, event timing, and constituent transport and sorption properties. The Site is located on the southwestern portion of the Plant Yates property **Figure 1**. Groundwater at the Site is monitored using a comprehensive multi-unit monitoring system of wells installed to meet federal and state monitoring requirements. Routine sampling and reporting began in 2017 after the completion of eight background sampling events. Based on groundwater conditions at the Site, an assessment monitoring program was established on January 14, 2018, at AP-3, AP-B, and AP-B'; in September 2019 for AP-A; and on January 31, 2020 for the R6 CCR Landfill.

CCR from the ash ponds placed within the AMA waste footprint is dewatered, moisture conditioned, spread, compacted, and capped with the final cover system. The final cover system will be graded to prevent erosion, provide adequate levels of slope stability, and promote positive drainage for surface water runoff. The cover system consists of a prepared subgrade overlain with a plastic liner covered by an engineered synthetic turf and a specified, treated sand infill material. The final cover system will eliminate infiltration to the maximum extent feasible.

[1] On behalf of Georgia Power, Arcadis has prepared a Groundwater Monitoring and Corrective Action Report (Arcadis 2021a) that identifies Appendix IV constituents detected in groundwater at SSLs above the GWPS.

CCR placement in the R6 CCR Landfill ceased in October 2015. Closure construction for the R6 CCR Landfill consisted of closure in place and covered in accordance with its closure plan. R6 CCR Landfill cover installation started September 2014 and was completed December 2016. The final cover consists of a minimum 18-inch thickness infiltration barrier layer of clayey soil placed and compacted in accordance with the design specifications and a 6-inch minimum thickness surface layer of topsoil capable of supporting vegetation. Numerous clay liner samples were collected from 57 locations at the R6 CCR Landfill, and laboratory testing indicated that the permeability of the clay liner ranges from 8.7E-08 centimeter per second (cm/sec) to 9.5E-06 cm/sec with a geometric mean of 2.7E-6 cm/sec, which is expected to significantly reduce the infiltration into the CCR material (SCS, 2022). Following completion of closure, the R6 CCR Landfill and AMA will enter post-closure care for a minimum period of 30 years.

Georgia Power is implementing an Engineering Measure drain to enhance the protection of groundwater and closure effectiveness. The Engineering Measure drain is a sub-surface drainage system installed in 2019 with pumping risers for the collection and conveyance of subsurface water. The purpose of the subsurface Engineering Measure drain, associated risers, and pumps is to collect and remove groundwater from the area, which will result in lowering the potentiometric surface within the R6 CCR Landfill and the AMA.

Regional Climate, Topography, and Hydrology

The climate of Newnan, Georgia is characterized as humid continental with an average rainfall of approximately 51.4 inches annually, based on 85 years of data from weather station Newnan 4 NE, located approximately 10 miles southeast of the Site. The average maximum temperature is 74.5 degrees Fahrenheit (°F), and the average minimum temperature is 49.9 °F with an average temperature around 61 °F. The warmest time of year is generally early to mid-August, when highs are regularly around 91.6 °F with temperatures rarely dropping below 69.7 °F at night.

Topography near Plant Yates is characterized by moderate relief. Plant Yates is located within the northeast quarter of the Whitesburg, GA United States Geological Survey (USGS) 7.5-minute topographic quadrangle (USGS, 1965). Elevations range from approximately 700 feet above mean sea level (msl) in areas close to the river to more than 800 feet msl near the northern portion and a maximum of 870 feet near the southern portion of the Site (ACC 2020). Drainage across the Site occurs from both the northern and southern areas towards a central valley and then to the Chattahoochee River. The nearest active USGS monitoring station (02338000) is located on the Chattahoochee River at U.S. Highway 27, approximately 2 miles north of the Site.

Geology and Hydrogeology

Plant Yates is in the Inner Piedmont Physiographic Province of western Georgia, immediately southeast of the Brevard Zone, a regional fault zone that separates the Piedmont from the Blue Ridge. Rock units at Plant Yates are primarily interlayered gneiss and schists. The rocks in the area have been subjected to extensive metamorphism, deformation, and igneous intrusions. Surface expressions of fracture sets and their orientation include rectilinear drainage and lineaments shown on topographic maps and aerial photos of the Plant Yates area (ACC 2020), which indicate fractured bedrock.

A layer of soil up to 10 feet thick overlays the saprolite. The saprolite extends 20 to 40 feet below ground surface (bgs), was formed in place by the physical and chemical weathering of the underlying metamorphic rocks. The saprolite typically consists of clay- and silt-rich soils that grade to sandy soils with depth. A zone of variable thickness (approximately 5 to 20 feet) of transitionally weathered rock typically exists between the saprolite and competent bedrock. The lithology of this zone is highly variable and ranges from medium to coarse unconsolidated material to highly fractured and weathered rock fragments. Localized alluvial soils consisting of generally coarser material (silty-sand, clayey silt, and silty clay with well-rounded gravel and cobbles) are associated with present river and stream channels (Arcadis 2021a).

At Plant Yates, groundwater is typically encountered slightly above the saprolite/weathered rock interface. Groundwater flow in the saprolite zone is through interconnected pores and relict textures and fractures. As the rock becomes increasingly competent with depth, groundwater flow occurs mainly through joints and fractures (i.e., secondary porosity). Recharge to the water-bearing zones in fractured bedrock takes place by seepage through the overlying mantle of soil/saprolite or by direct entrance through openings in outcrops. The average depth of the water table at Plant Yates varies with topography, ranging from approximately 5 to 50 feet bgs. The water table occurs in the saprolite and in the transitionally weathered zone, at least several feet above the top of rock (Arcadis 2021a).

Current Groundwater Flow Direction

Saprolite, transition zone, and shallow bedrock groundwater elevation data were used to prepare potentiometric surface elevation contour maps for September 2020 (Arcadis, 2021a). Groundwater elevations ranged from 728.37 feet (PZ-35) to 796.55 feet (YGWA-39). The general site-wide groundwater flow direction is from the east to west, with localized flow direction controlled by surface water bodies and eventually towards the Chattahoochee River. The groundwater flow direction for the saprolite, transition zone, and shallow bedrock wells is generally towards the west, northeast, and east from the southern portion of the R6 CCR Landfill area, which serves as a topographic high point (Arcadis, 2021a). Groundwater flows west from the eastern portions of the AMA, Ash Pond 3, and Ash Pond B' areas to the central portion of the Site. The groundwater flow direction is consistent with historical patterns (ACC, 2020).

Nature and Extent of Groundwater Selenium

Selenium concentrations above the groundwater protection standards are noted at two wells, YGWC-38 and PZ-37, located on the southeastern side of R6 CCR Landfill. Selenium concentrations below the GWPS ranging from 0.03 to 0.043 mg/L are observed in two wells, YGWC-41 and YGWC-42, located on the southwestern side of the R6 CCR Landfill. The spatial extent of selenium in groundwater is limited to two areas of the R6 CCR Landfill and these two areas have a relatively small footprint compared to the landfill area.

Wells with elevated selenium concentrations (YGWC-41, YGWC-42, YGWC-38, and PZ-37, and YAMW-5) have demonstrated decreases in concentrations since closure of the R6 CCR Landfill at the end of 2016. The Geochemical CSM (Arcadis 2022a, Appendix B) has time-series plots of groundwater analytical data illustrating changing groundwater conditions due to CCR pond closures. Decreasing selenium concentration trends are observed on the southeast side of the unit at YGWC-38 and PZ-37. On the west side of the R6 CCR Landfill, selenium concentrations at YGWC-41 have decreased from a maximum of 0.071 milligram per liter (mg/L) in February 2018 to 0.027 mg/L in August 2021, below the GWPS of 0.05 mg/L. Selenium concentrations in well YGWC-42 also decreased from the maximum concentration of 0.059 mg/L (October 2017) and stabilized to 0.043 mg/L in August 2021, below the GWPS. Monitoring wells YGWC-41, YGWC-42, and YAMW-5 have never statistically exceeded the GWPS and are therefore not the subject of the Draft Remedy Selection Report. However, selenium data from these wells was useful in calibrating the model to field conditions, so information pertaining to these wells is included herein.

Model Objectives

The primary objective of the groundwater transport model is to support evaluation of two corrective measure alternatives (Alternative 1 – MNA; Alternative 2 – In-Situ Injections) evaluated in the remedy selection study and to estimate the timeframe in which the GWPS can be met at the compliance boundary for each of the remedial alternatives at wells YGWC-38 and PZ-37, located on the southeastern side of R6 CCR Landfill. The timeframe is considered in the comparative criteria for evaluation of the two alternatives. The model is also designed to simulate historical average flow conditions and the fate and transport of constituents from historical periods through post-closure. This includes model calibration to historical water quality conditions done in preparation for post-closure predictive modeling.

Model Scope

The transport modeling scope includes primarily three tasks as illustrated below:

- Develop and calibrate a historical transport model using historical data.
- Develop a predictive transport model.
- Evaluate proposed corrective measures to assess time to achieve GWPS at YGWC-38 and PZ-37 and evaluate concentration reductions in YGWC-38 and PZ-37 and surrounding wells during the remedy period.

The simulation of contaminant fate and transport requires specification of various transport parameters that control the rate, movement, mixing, and geochemical equilibrium of constituents in the subsurface. The transport model relies on the updated groundwater flow model and most recent water level and water quality data. For this transport modeling analysis, the fate and transport of selenium were simulated by incorporating the processes of advection, adsorption (assuming geochemical equilibrium and geochemical reactions), and mixing.

Development of the transport model includes the estimation of the historical ash distribution, transport parameters and geochemical processes that reasonably represent the fate and transport of selenium. Historical aerial photos and operational history provided by SCS were used to understand the ash placement sequence and to provide a basis for delineating ash source and extent. Site data were used to calibrate the simulated selenium leaching concentrations from CCR materials in the R6 Landfill (Arcadis 2022a, Appendix B).

To begin the historical calibration, a historical transport model consisting of two phases was developed to evaluate fate and transport of selenium from the beginning of landfill operations to the current period (i.e., 1978 through 2020). The transport model was calibrated by replicating observed temporal trends in selenium concentrations to improve confidence in the model's predictive ability. Ash source extent and concentration and other transport parameters were adjusted systematically to match historical selenium water quality data collected from nearby monitoring wells

After calibration, the model was applied for predictive modeling of closure conditions. The calibrated groundwater transport model serves as the basis for performing long-term transient evaluations of proposed corrective measures in the remedy selection study.

Transport Model Description

The simulation of the fate and transport of solutes in a groundwater transport model is based on the three-dimensional groundwater flow model structure and simulated groundwater flow field. A thorough discussion of the development and calibration of the existing groundwater flow model is included in the previous modeling report submitted in 2020 (TRC 2020). The previous modeling report included the basis for conceptualization of the hydrostratigraphy, hydrogeology, and groundwater/surface water dynamics at the Site as well as a preliminary evaluation of the groundwater flow condition and closure approach proposed at the Site.

Before developing the transport model, Arcadis updated the existing numerical groundwater flow model to incorporate recent bathymetry data collected from the Chattahoochee River and CCR ponds to represent on-site pond features more accurately during the flow model simulation. Transient climate data, including rainfall and evapotranspiration (ET), were also included to improve representation of the water balance at the Site. The updated groundwater flow model resulted in adjustment of the model domain and model structure adjustments for new data with a more detailed hydrostratigraphic framework including structural data collected in the vicinity of the Engineering Measure drain. The updated groundwater flow model was calibrated to 2017 observed water levels under steady-state conditions. The steady-state heads were then used as a starting condition for a transient simulation for calibration to groundwater levels from 2018 to 2020. The transient simulation included changing stresses such as pond closure, seasonal rainfall and ET. Additionally, hydraulic conductivity zones and values were updated with additional slug testing results from each hydrostratigraphic unit. Residual statistics for the steady-state calibrated groundwater flow model indicate good agreement between simulated and measured groundwater elevations and to replicate observed temporal trends in groundwater elevations. The simulated groundwater elevations and groundwater flow directions are consistent with historical patterns based on observed water levels. The model indicates groundwater flow direction for the saprolite, PWR, and shallow bedrock wells is generally towards the west, northeast, and east from the southern portion of the R6 CCR Landfill. Groundwater flows west from the eastern portions of the AMA, Ash Pond 3, and Ash Pond B areas to the central portion of the Site. The model also simulates the vertical motion of groundwater, e.g., primarily vertically downward gradients near recharge divides (topographic ridge areas) then transitioning to vertically upward gradient near groundwater discharge features. Across the R6 CCR Landfill area vertical gradients transition from downward in the upland area to upward towards the downgradient area of the Landfill.

An initial performance test of the Engineering Measure drain was completed in early 2022 after the flow model calibration period was completed. The as-built Engineering Measure drain was also incorporated and simulated during the post closure period in the updated model. The model predicted Engineering Measure drain extraction rates were found to be consistent with the rates achieved during the performance test.

After the groundwater flow model was constructed and calibrated, a site-specific transport model was developed to evaluate the current and future migration potential of selenium under the selected corrective measure scenarios. The transport model was first calibrated using historical source conditions to match recently observed concentration data, afterwards the model was used in a predictive manner to evaluate the fate and transport of constituents for the two alternatives including MNA and geochemical manipulation via In-Situ Injection.

Transport Model Description

Code Selection

Arcadis used the transport module Block-Centered Transport (BCT) process of MODFLOW-USGT (unstructured grid transport) (Panday 2017; Panday 2020), which is fully integrated with the existing MODFLOW-USGT groundwater flow module for the transport modeling application. MODFLOW-USGT is publicly available, features extensive code documentation and verification, and was developed to accommodate solute migration between the groundwater flow (GWF) domain and a connected linear network (CLN) domain as part of the solution.

MODFLOW-USGT solves the groundwater flow equation and provides the cell-by-cell flows used by the transport function to develop a velocity field for the transport simulation. MODFLOW-USGT code has a comprehensive set of options and capabilities for simulating advection, sorption/desorption, dispersion/diffusion, and chemical reactions of constituents in groundwater flow systems under various hydrogeologic conditions. The MODFLOW-USGT code was used for this modeling assessment because:

- It was fully compatible with the MODFLOW-USGT flow module; and
- It incorporates the dual-domain formulation.

The dual-domain formulation mentioned above is a more realistic alternative to the classical single-domain advection-dispersion equation, making it the most up-to-date platform for state-of-the-art transport modeling. The dual-domain approach conceptualizes aquifer heterogeneities by representing the aquifer as two overlapping domains: (1) a mobile domain in which transport through the aquifer matrix is dominated by advection and (2) an immobile domain in which transport occurs mainly through diffusion. These domains are defined in terms of mobile and immobile porosity.

Typically, as a pulse of constituent mass migrates through the porous media, portions of the constituent plume move quickly in the migratory pore space, while other portions of the plume diffuse and migrate into less mobile zones (Anderson et.al, 2015). Eventually, as the bulk of the plume mass migrates past a point in the system, mass stored in the less mobile zones diffuses or contributes mass back into the more active pore space through diffusion (Gillham et al. 1984). Mass transfer into and out of the less mobile zone is generally slow because the process is controlled by diffusion. A mass-transfer coefficient is used to characterize the exchange between the two domains (porosities). This effect is described clearly in the literature as well as the mathematics to support the concept (Gillham et al. 1984; Molz et al. 2006; Flach et al. 2004; Harvey and Gorelick 2000; Feehley et al. 2000; Julian et al. 2001; Zheng and Bennett 2002). The following expression describes the dual-domain model for a given contaminant:

$$\theta_m \frac{\partial C_m}{\partial t} + \theta_{im} \frac{\partial C_{im}}{\partial t} = \frac{\partial}{\partial x_i}(\theta_m D_{ij} \frac{\partial C_m}{\partial x_j}) - \frac{\partial}{\partial x_i}(q_i C_m) + q_s C_s$$

$$\theta_{im} \frac{\partial C_{im}}{\partial t} = \beta (C_m - C_{im})$$

Where C_m is the solute concentration in the mobile domain, C_{im} is the solute concentration in the immobile phase, C_s is the boundary source concentration, θ_m is the porosity of the mobile domain, θ_{im} is the porosity of the immobile domain, and β is the first-order mass transfer rate coefficient between the mobile and immobile domains. Note: $\theta_{total} = \theta_{im} + \theta_m$. D_{ij} is the hydrodynamic dispersion tensor, q_i is the specific discharge, and q_s is the volumetric flow rate per unit volume of aquifer representing fluid sources (positive) or sinks (negative).

Transport Parameters

The simulation of contaminant fate and transport requires specification of various transport parameters that control the rate, movement, mixing, and adsorption of site-related constituents in the subsurface. The following sections discuss the initialization of various transport parameters.

Adsorption

Adsorption is the process by which a solute adheres to a solid surface. Adsorption results in the solute, which was originally in solution, to become distributed between the solution and the solid phase, a process called partitioning. As a result of adsorption, a solute will move more slowly through the aquifer than the groundwater. This effect is called retardation. Adsorption is mathematically represented using a partitioning coefficient (Kd), which is the ratio of the concentration of the constituent in the sorbed (i.e., solid) phase to the concentration of the constituent in the dissolved phase:

$$K_d = \frac{C_s}{C_d}$$

Where Cs is the concentration of the constituent in the sorbed phase (milligrams per kilogram [mg/kg]), and Cd is the concentration of the constituent in the dissolved phase (mg/L).

To assess the sorption mechanisms, capacity, and stability of the aquifer matrix to attenuate dissolved selenium in groundwater, a series of bench-scale sorption tests was completed on the saprolite and bedrock solids (Arcadis 2022a, Appendix B). The bench-scale sorption tests incorporated groundwater collected from YGWC-38, where the initial concentration of selenium was approximately 0.075 mg/L. Soil samples used were representative of saprolite and gneiss bedrock (Arcadis 2022a, Appendix B). The results of the sorption test suggest that the saprolite capacity was 0.008 to 0.13 μg/kg, and the fine-grained bedrock capacity was 0.007 to 0.009 μg/kg. No measurable sorption was observed for the coarse-grained bedrock sample during the test. Sorption coefficient (Kd) values of 0.12 liter per kilogram (L/kg) to 0.25 L/kg were also calculated for saprolite, 0.1 to 0.16 L/kg for the fine-grained bedrock sample and 0.0 L/kg for coarse-grained bedrock sample from the study. Sorption results measured from the bench-scale test were used to initialize the adsorption parameter in the model and were further adjusted within the parameter range during calibration. The calibrated partitioning coefficients (Kd) for selenium were 0.2 L/kg, 0.12 L/kg, and 0 (zero) L/kg for saprolite, partial weathered bedrock, and bedrock, respectively (**Table 1**).

Mobile and Immobile Porosity

Dual-domain approach is appropriate for use in fractured media or heterogenous porous media. Given the hydrogeological setting at Plant Yates, solute transport was simulated using the dual-domain option that requires assignment of two porosity terms: mobile and immobile porosity. The mobile porosity is the mobile domain in which most groundwater flow and transport occur, whereas the immobile porosity represents the immobile domain, in which groundwater velocity is much slower and transport is dominated by molecular diffusion. Molecular diffusion is the result of the thermal motion of individual molecules which causes a flux of dissolved solutes from area of higher concentration to areas of lower concentration and it dominates the solute transport when groundwater is relatively stagnant in the immobile domain. Compared to a single domain model, the dual domain better represents the amount of solute mass in a system because both mobile and immobile porosities are used, however, the advection is based only on the mobile porosity.

Arcadis performed a geotechnical analysis and geophysical borehole investigation to provide additional characterization of porosity for the on-site hydrogeologic units. Geotechnical analysis (Timely Engineering, 2021) indicates an average total porosity of 37 percent for saprolite and partially weathered rock (PWR). Total porosity was partitioned into a 17 percent mobile porosity and a 20 percent immobile porosity based on field measurements (Arcadis, 2021b) and transport calibration. These values are consistent with literature values (Payne et al. 2008; Fetter 2001), as well as Arcadis' experience at similar sites with overburden materials and semi-consolidated deposits. The acoustic televiewer log from the installation of bedrock wells PZ-52D and PZ-53D (Arcadis 2021b) was used to identify void space and measure aperture thickness and orientation. The porosity can be estimated by the ratio of cumulative aperture thickness over the total thickness of the bedrock units in which the apertures were observed over the interval of that specific bedrock unit. Note that additional geologic information should be considered when evaluating the interconnectivity of various fracture zones because it cannot be directly inferred from the geophysical boring study alone (Arcadis 2021b). The estimated porosity values were refined during the historical transport calibration. **Table 1** presents the calibrated mobile and immobile porosity in the transport model.

Mass Transfer Coefficient

The diffusive exchange between the mobile and immobile domain discussed above is typically defined by a lumped kinetic mass transfer term that takes into account the size and nature of small-scale heterogeneity. Mathematically, the mass transfer coefficient (MTC) describes the rate at which contaminant mass transfers between the mobile and immobile fractions in the model. The MTC values were calibrated to be 1×10^{-4} (1/day) in model layers 1 through 4 and 1×10^{-5} (1/day) in model layers 5 through 6 to evaluate the effects on plume movement during the historical transport calibration. These values are within the range of literature values for models of similar dimensions and aquifer properties (Gillham et al. 1984; Molz et al. 2006; Flach et al. 2004; Harvey and Gorelick 2000; Feehley et al. 2000; Julian et al. 2001).

Dispersion

Dispersion causes the paths of dissolved chemicals to diverge and spread from the average direction and speed of groundwater flow. Dispersion is the sum of mechanical dispersion and molecular diffusion and can be effectively approximated by dispersivity times fluid velocity. Dispersivity can be further decomposed into three principal components (Bear 2012) due to heterogeneity of aquifers as list below:

- longitudinal,
- horizontal transverse, and
- vertical transverse

Field measurements from Gehar et.al (1992) showed an order of magnitude higher ratio of longitudinal to horizontal transverse dispersivities, and in all cases, the vertical transverse dispersivity is one to two orders of magnitude smaller than the horizontal transverse dispersivity The dispersivity trends in the overburden – fractured bedrock aquifer at Plant Yates is also expected to follow anisotropic pattern with a higher horizontal dispersivity because of low-angle, near-horizontal fractures predominant in the bedrock, as evident from borehole geophysical data from the site and groundwater flow expected to follow relict foliations in the overburden, as evident in the borehole lithological data. At the Plant Yates Site, longitudinal dispersivity, horizontal transverse dispersivity, and vertical transverse dispersivity were calibrated be 10 ft, 1 ft, and 0.1 ft, respectively to represent the anisotropic spreading of solute plumes due to heterogeneity.

Historical Transport Calibration

Calibration of the transport model was performed with numerous simulations of relevant transport parameters discussed above that would affect selenium transport in groundwater at the Site. The ultimate goal was to develop a transport model to simulate the selenium concentrations under current and future closure conditions under different corrective measure alternatives. Due to uncertainties regarding the occurrence and distribution of selenium concentrations at the R6 CCR Landfill boundary, historical transport simulations were performed to simulate constituent concentrations observed through time at the perimeter monitoring wells. The transport calibration was completed by specifying historical source terms at the R6 CCR Landfill area in the model and simulating the resulting selenium distribution from 1978 to 2020. A soil cover was installed at the R6 CCR Landfill as part of the R6 closure. During the historical transport simulation period from 1978 to 2020, the infiltration rate over the R6 CCR Landfill from 1978 to 2014 was calibrated to 17 inches per year (in/yr), which represents the average natural groundwater recharge before capping. For the remainder of the period from 2014 to 2020, the calibrated infiltration rate of 1 in/yr (ACC, 2020) was used, which represents the infiltration rate after installation of the soil cover between 2014 and 2016. The effects of source strength and extent, as well as transport parameters, were adjusted until the selenium concentrations and trends computed by the model reasonably matched measured concentrations over time. The source strength and extents were implemented in the model by assigning recharge concentrations over the R6 CCR Landfill area. The recharge concentrations were continued throughout the historical transport calibration period.

Historical Source Development

Based on historical aerial photographs and an engineering plan submitted in 1984 (Hendon, 1984), the placement of CCR material in approximately 73 acres at the R6 CCR Landfill area likely started in 1978 (**Figures 2 A, B, and C**). From 1978 to 1999, CCR material placement had approximately covered the entire area of the R6 CCR Landfill according to the proposed phasing plan in the engineering design document (**Figures 2 A**). From 1999 to 2014, placement was expanded vertically by stacking, spreading, and compaction of ash within the grading limits. Starting in approximately September 2014, the Phase I final cover was installed over the southern R6 CCR Landfill area. After completion of the Phase I cover, the Phase II final cover installation continued over the northern R6 CCR Landfill area and was completed around December 2016 (**Figure 2B)**. Based on the communication with SCS/GPC and received design documents, some CCR materials found outside of the current R6 CCR Landfill boundary were excavated and removed during the cover installation (**Figure 2C**).

Historical transport simulations were developed to model the placement of CCR materials into different areas within the R6 CCR Landfill overtime (1978 to 2014), cover installation at R6 CCR Landfill (2014 to 2016), and post-closure period of R6 CCR Landfill (2017 to 2020). **Table 2** outlines the model stress periods of the historical transport model simulation. From stress periods 1 through 9, the transport model was run as steady-state flow –

transient transport mode because the hydraulic conditions are anticipated to have remained relatively constant from 1978 to 2016. Between 2017 and 2020, the transport model was run as transient flow – transient transport mode to be consistent with time discretization of the calibrated flow model and because a majority of water quality data became available in 2017 for concentration matching.

Figure 3 shows the calibrated source footprints of selenium distribution under the R6 CCR Landfill. These source footprints or zones were assigned as recharge concentrations in the model and the source mass flux or loading is represented by the product of the recharge rate and the recharge concentration. Initially, the shape and extent of the source areas were delineated based on historical aerial photographs and the engineering plan of CCR placement (Hendon, 1984). Initial estimates of the source concentrations were based on the maximum observed concentration sampled from R6 CCR Landfill monitoring wells. The ash extent changed slightly due to CCR removal that happened in parallel with cover installation from 2014 to 2016 (SCS 2014), and the source footprint was revised to align with the existing R6 CCR Landfill boundary. During the historical transport calibration, the shape and extent of the source footprint, including source strengths, were adjusted within reason to obtain an acceptable match between simulated groundwater concentrations and temporal-measured concentration distributions for selenium. Because the recharge rate across the R6 CCR Landfill varies over time, the associated source mass loading also varies with the recharge rate, i.e., the source mass loading is reduced after capping. Note that the source concentrations were not assigned on the north side of the R6 CCR Landfill, as they are not sensitive to the simulated selenium concentrations at the existing monitoring well network around the R6 CCR Landfill during transport calibration.

Transport Calibration Methodology

No groundwater chemistry data are available historically until after June 2016, when initial groundwater samples were taken from monitoring wells at the perimeter of the R6 CCR Landfill. Groundwater concentration data have been collected for selenium since 2016.

The transport stress periods were derived based on the ash deposition sequence, installation of the R6 CCR Landfill cover, and transient flow calibration period. Transport calibration was performed by adjusting basic transport parameters including source concentration and extent to match water quality data. The observed selenium concentrations were compared with simulated concentration values to evaluate the quality of the fit between observed and simulated values.

Transport Calibration Results

Table 1 presents the calibrated transport parameters for different model layers. Adsorption (Kd), porosity, and MTC are the main factors that affect the calibrated model. After numerous transport simulations, the following parameter zonation and values were found to produce the best match between the observed and simulated concentrations and trends for selenium from 2016 to 2020:

- K_d values of 0.2 L/kg, 0.2 L/kg, 0.12 L/kg, and 0 L/kg for selenium in Layers 1, 2, 3, and 4 through 6, respectively;
- An MTC value of 1×10^{-4} (1/day) and 1×10^{-5} (1/day) in Layers 1 through 4, and Layers 5 through 6, respectively;
- Mobile and immobile porosity as shown in **Table 2**; and

- Calibrated source concentrations and source extent shown on **Figure 3.**

Figure 3 presents the model calibrated selenium extent and concentration under the R6 CCR Landfill. Transport calibration estimated higher source concentration on the southeast and southwest sides of the unit, which are consistent with selenium concentrations observed at YGWC-38, PZ-37, YAMW-5, YGWC-41, YGWC-42, and YGWC-43. **Figure 4** shows a comparison of observed versus simulated selenium concentration hydrographs, particularly between 2016 and 2020. Nearby monitoring wells (YGWA-39, YGWA-40, YGWC-23S, PZ-52D, and YAMW-3) were also selected as calibration targets to provide spatial constraints during source concentration estimation. At each well, temporal water quality data were reviewed, and only measured concentration values with valid lab qualifiers (i.e., J - the reported value is above the method detection limit [MDL] but below the reporting limit) were selected for concentration matching. Water quality data with a "U" qualifier (i.e., U- the analyte was not detected in the sample above the MDL) were not considered a valid concentration target value during transport calibration. **Figure 4** illustrates the color code meaning for each data qualifier.

On the west side of the R6 CCR Landfill, the observed selenium concentration hydrographs at monitoring wells YGWC-41 andYGWC-42 show a decreasing concentration trend following the R6 CCR Landfill cover installation. The simulated selenium concentrations show that the transient transport simulation successfully matches the observed selenium concentrations and declining trends during the simulation period. The calibration concentrations and trends illustrate a good fit to the data, except when the concentrations were (low) nearer to the MDL. For example, the transport model overestimated the selenium concentration of 0.006 mg/L at YAMW-3 compared to the observed concentration of 0.0013 mg/L with the MDL qualifier. However, the simulated selenium is considered conservative given the MDL variation and low selenium concentration, which is almost an order of magnitude lower than the federal GWPS of 0.05 mg/L.

On the southeast side of the R6 CCR Landfill unit, the calibrated concentration plots also indicate reasonable matches between the modeled and observed selenium concentrations at the nearby monitoring wells (YGWA-40, YGWC-38, PZ-37, YAMW-5). At YGWC-38, it shows a satisfactory match of the simulated selenium concentrations and trends to the observed concentration data. The sharp drop of observed concentration at YGWA-39 is attributed to a change in MDL value similar to that at YGWC-43. No water quality data are available at PZ-52D during the transport calibration period between 2016 and 2020, as this well was constructed in 2021. However, a sample collected in November 2021 was used as a qualitative constraint to evaluate the transport calibration at PZ-52D. The simulated selenium concentration of 0.0025 mg/L at the end of 2020 matches reasonably well to the measured selenium concentration of 0.0034 mg/L in November 2021. The model slightly overestimated the selenium concentration as 0.057 mg/L at YGWC-23S compared to the observed concentration of 0.037 mg/L. Numerous calibration simulations were performed to try to achieve a balance of over- and underpredictions across wells YGWC-38, YGWC-23S, and PZ-37. Overall, there is a reasonable fit of measured and simulated concentrations, given the low concentrations of selenium noted at several wells.

Based on the ability of the model to provide a satisfactory match between observed and simulated selenium concentrations, the transport model calibration has demonstrated its robustness to estimate the spatial distribution of the source extent and assumed source concentrations, determine the appropriate transport parameters, and to simulate the temporal trend of the observed change in selenium concentration after the closure of the R6 CCR Landfill. During calibration, sensitivities of various transport parameters were evaluated. Dispersivity and porosity for the deep bedrock units were only mildly sensitive, therefore reasonable values from literature were used to define those parameters in the transport model. Overall, the calibrated groundwater transport model is a valid tool to simulate selenium transport and evaluate the effect of various remedial alternatives at the R6 CCR Landfill at Plant Yates.

Predictive Transport Simulation

Following the development and calibration of the historical transport model, predictive transport model scenarios were developed to simulate selenium transport for the two corrective measures alternatives being evaluated for remedy selection. The magnitude and distribution of selenium source concentrations calibrated during the historical transport calibration was continued in the predictive simulations. However, the mass flux of selenium to groundwater is significantly reduced by the R6 CCR Landfill cover installation since 2017.

The predictive transport model was developed to represent a post-closure period of 30 years. **Table 3** outlines the stress period setup of the predictive transport model. The predictive transport model was run using quarterly stress periods for 4 years, followed by a 1-year stress period, and then a single 25-year stress period. The predictive transport model incorporated relevant closure conditions that have hydraulic impact on groundwater flow and transport at the Site, primarily at the R6 CCR Landfill and AMA. Details of closure are described in the Draft Remedy Selection Report (Arcadis 2022a) and Annual Groundwater Monitoring and Corrective Action Report (Arcadis 2022b). The groundwater heads and selenium distribution from the end of the historic transport calibration (i.e., December 2020) were used as the starting condition for the predictive transport scenarios in 2021. The recharge source concentration distribution over the R6 CCR Landfill was also continued in the predictive simulations.

In summary, CCR material is being consolidated into the AMA and R6 CCR Landfill area, and both are being capped to reduce impacts to groundwater by eliminating or significantly reducing precipitation infiltration through CCR materials. Distinct from the two corrective measures being considered at the Site, an Engineering Measure drain has been constructed along the portions of the eastern and northern boundary of the R6 CCR Landfill as part of the closure design for the site (SCS, 2019). The purpose of the Engineering Measure drain, associated risers, and pumps is to collect and remove groundwater from the area, which will result in lowering the potentiometric surface within the R6 CCR Landfill and the AMA. The effect of the decrease in the groundwater elevation translates into a reduction in the volume of CCR present below the potentiometric surface compared to pre-closure conditions (TRC 2020). When simulating the active dewatering of Engineering Measure drains through the pump risers, drain boundary cells were connected to the CLN cells that represented the pump riser locations (**Figure 5**). The groundwater extraction from the Engineering Measure drain can be regulated by adjusting drain elevation of the connected drain boundary cells. When the drain elevation is lowered at the connected drain boundary cells, the extracted flows will be reduced and vice versa. This head dependent flow approach is used to prevent over-drafting at the pump risers. Effectively, the drains operate like pumps set with a head or elevation control to limit pumping. To evaluate appropriate pumping rates from subsurface drains, the model was run to steady-state conditions first to assess potential capture extent at various drain elevations or flow rates. Based on the assessment of corrective measures process, Arcadis has identified two corrective measures as potential alternatives. Both alternatives were modeled for the remedy selection evaluation.

Predictive Transport Scenarios

Alternative 1: Monitored Natural Attenuation – MNA

Alternative 1 is defined as the reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) within a timeframe that is reasonable compared to that offered by other more active methods (USEPA 2007). MNA is a remedial solution that takes advantage of natural attenuation processes to reduce constituent concentrations in groundwater. The conceptual remedy design for Alternative 1 is shown on **Figure 5**.

Since the Engineering Measure drain is part of the groundwater control measure in the closure design, this feature was also incorporated into the MNA alternative scenario. Calibrated transport parameters (source area concentrations, porosity, MTC, and adsorption partition coefficient) were used to simulate the advection, dispersion, dilution, and sorption mechanisms of selenium transport for the long-term predictive simulation at the Site. The Engineering Measure drain (subsurface drain) was represented with CLN cells in the model at locations according to the survey coordinates from the as-built drawings. Conductance values were assigned to each CLN cell to represent the interaction between the subsurface drain (CLN cells) and the surrounding aquifer (groundwater cell). The conductance term of 6,800 square feet per day (ft^2/d) is based on a drain design of a 4-foot bedding width, 20-foot model grid node length, and a 1-foot-thick aggregate layer of the crushed stone with a hydraulic conductivity of 85 ft/d (TRC, 2020).

Other groundwater control measures were incorporated during the development of both alternatives. The cover system at AMA consists of a prepared subgrade overlain with a plastic liner and covered by an engineered synthetic turf. The final cover system will eliminate infiltration through the CCR. The final cover system on the R6 CCR Landfill consists of a minimum 18-inch infiltration barrier layer of clayey soil, placed and compacted in accordance with the design specifications, and a 6-inch minimum surface layer of topsoil capable of supporting vegetation growth. As a result, groundwater recharge rates of 0 in/yr and 1 in/yr were assigned at the AMA and the R6 CCR Landfill, respectively, to simulate the impact of the cover system on infiltration through the CCR units.

Alternative 2: In-Situ Injections

Alternative 2 includes the transport mechanisms and groundwater control measures included in Alternative 1 and also includes the application of reagents in the subsurface to influence the solubility, mobility, and/or toxicity of inorganic constituents. The injection of a chemical or organic substrate is intended to alter geochemical conditions to those more favorable for stabilization of selenium concentrations.

In-Situ Injections can stabilize selenium concentrations by altering geochemical conditions in groundwater. For purposes of comparison, the model assumes the injections will use zero-valent iron (ZVI) to immobilize selenium through reduction and adsorption. They are incorporated into the model along two transects to create in-situ reactive zones such that, as groundwater passes through the zone, selenium will be immobilized. Each transect in the model consists of approximately 15 to 20 injection points, spaced 10 feet apart, with injections occurring in impacted saprolite and PWR units. The conceptual remedial design for Alternative 2 is shown on **Figure 6**.

The effect of selenium removal by ZVI was modeled through the degradation module of MODFLOW USG. A degradation zone of 200 feet wide and 20 feet long (along the current groundwater flow direction) was delineated in the model to simulate the reaction process of selenium with ZVI. No site-specific half-life of selenium reduction through ZVI was available; however, a literature study indicated that the half-life of selenium reduction is less than 2 hours (Liang et al. 2013). To be conservative, a safety factor of 2 was used, resulting in a simulated half-life of 4 hours within the degradation zone to represent in-situ treatment of selenium in the transport model. Note that the reaction process was only simulated within the degradation zone shown on **Figure 6** within the saprolite and PWR to target the higher selenium concentrations. It is assumed that the injected ZVI would fully contact groundwater within the degradation zone. No degradation zones were needed or simulated in the lower units of the model due to minimal selenium concentrations. The model assumed that full-scale in-situ injection would start in year 2025 after the implementation of pilot test and the full-scale injection system.

Transport Simulation Results

Simulated groundwater elevation contours and capture extent are presented in **Figure 7** when the Engineering Measure drain is pumping at about 80 gallons per minute (gpm) under steady-state conditions. It should be noted that the time varying rates of the Engineering Measure drain in the model are consistent with recent performance testing of the Engineering Measure drain.

The desired combination of drain elevations was then simulated transiently to represent the long-term operation of the Engineering Measure drain. The Engineering Measure drain was not active during the first year of the predictive transport simulation and was simulated to be active in 2022. However, the Engineering Measure drain has yet to be activated. The model simulation suggests that the dewatering rates of the Engineering Measure drains would follow an exponential reduction, as groundwater levels are continuously being lowered near the Engineering Measure drain. **Figure 8** shows the initial simulated pumping rate of the Engineering Measure drain to be as high as 200 gpm, followed by a gradual decline to the steady-state flow rate of about 80 gpm over the next 6 years from 2022 to 2028. The flow performance of Engineering Measure drain will be fully evaluated once the Engineering Measure drain goes to active operation.

Predicted selenium concentrations fall below the GWPS of 0.050 mg/L for each of the corrective measure options retained at the compliance boundary (R6 CCR Landfill boundary). **Figure 9** illustrates the long-term predicted selenium concentration plots at compliance monitoring wells around the R6 CCR Landfill. Wells that exhibited elevated selenium concentrations (YGWC-41, YGWC-38, PZ-37, and YAMW-5) have demonstrated decreases in concentration since closure of the R6 CCR Landfill in 2016. Currently, PZ-37 has the highest selenium concentration at 0.2 mg/L. The predicted selenium concentrations at PZ-37 indicate that Alternative 1 – MNA and Alternative 2 –In-Situ Injections would attain GWPS at Year 2032 (approximately 10 years of MNA monitoring) and by 2026 (within a year of in-situ operation), respectively. Predictive transport model simulations suggests that selenium concentrations at YGWC-38 and YGWC-23S would decrease to less than GWPS within 1 or 2 years of operation of either Alternative 1 or Alternative 2. The table below summarizes the final years to attain GWPS at compliance monitoring wells under each modeling scenario:

Monitoring Well	Alternative 1	Alternative 2
PZ-37	May 2032	December 2025
YGWC-38	August 2021	August 2021
YGWC-23S	March 2023	March 2023

Groundwater Transport Model Findings and Recommendations

Groundwater Model Findings

The transport modeling evaluation consisted of first performing a transport calibration of historical conditions to match observed concentration data, and afterwards, performing predictive simulations to assess the fate and transport of selenium for two corrective measures alternatives: MNA and In-Situ Injections.

During the historical transport calibration, satisfactory matches were achieved between observed and simulated selenium concentrations. The estimated extent of the sources for selenium were determined through calibration and suggest that the higher selenium concentrations are potentially located on the southeast side (near YGWC-38 and PZ-37) and the west side (near YGWC-41, and YGWC-42) of the R6 CCR Landfill. The maximum concentration of selenium was calibrated to 0.95 mg/L near monitoring wells YGWC-38 and PZ-37. The transport model replicated the decreasing concentration trend at various wells that have exhibited elevated selenium concentrations since the closure of the R6 CCR Landfill in 2016. The decreases in selenium concentration around 2016/2017 also demonstrate the effectiveness of cover installation of the R6 CCR Landfill in reducing groundwater infiltration. Thus, the calibration results have demonstrated reliability of the model and the model's ability to be used for predictive analysis of fate and transport of selenium under proposed corrective measure scenarios.

Following the development and calibration of the historical transport model, predictive transport model scenarios were developed to simulate selenium fate and transport for two corrective measures alternatives (MNA and In-Situ Injections). The model demonstrates that the Engineering Measure drain is an effective groundwater control measure for capturing groundwater under and reducing the saturation footprint of CCR materials at the R6 CCR Landfill and AMA. As groundwater levels decline, the pumping rates of the Engineering Measure drain exponentially declines and eventually attains a steady-state condition within 10 to 15 years of active pumping operation. Predictive transport model simulations suggests that the GWPS can be attained at the R6 CCR Landfill boundary within 10 years for either Alternative 1 or Alternative 2.

Future Work and Recommendations

The current groundwater monitoring program shows selenium concentrations exceeding the GWPS in two monitoring wells with a limited area on the southeast part of the Site and decreasing selenium concentration trends in these wells. The model developed for this study, agrees with the site monitoring data showing a limited area of selenium exceedances in groundwater (i.e., above GWPS) along the southeast side of the R6 CCR Landfill boundary. Predictive transport simulations also indicate attainment of GWPS at the waste boundary within the next 10 years. However, as with any modeling exercise, a level of uncertainty is present in the construction of a complex, multi-layer numerical transport model to predict water quality response to an action at an area of interest. Where the available data and information are lacking or infeasible to collect, assumptions were made regarding the various inputs into the model. As such, additional information and/or actions are recommended as detailed below.

- A monitoring well (YGWC-50) is planned at a location hydraulically downgradient of the R6 CCR Landfill along Dyer Road (ACC 2020) to sample the water quality and refine the CSM at this area after CCR removal activities are completed. Results from first sampling event could be used to better constrain the estimated source concentration of selenium in the transport model in north side of the R6 CCR Landfill.

- Transport simulation results suggests that the MNA alternative is favorable due to the reasonable remedial timeframe to attain the GWPS at the waste boundary. In-Situ Injection offers improvements in the time to attain the GWPS at the waste boundary. However, the effectiveness of ZVI for removal of selenium under site specific conditions is uncertain and would require bench testing and pilot testing to verify treatability and kinetics and to optimize iron dosing.

- Results from longer term operation of the Engineering Measure drain should be incorporated into the model to improve the parameter values assigned in the model near the R6 CCR Landfill.

- Continue monitoring of all groundwater monitoring wells during semi-annual sampling events to establish a comprehensive dataset of water level data and water quality data for future model updates and model evaluations.

- Updated information regarding ongoing closure should be represented in future updates to any predictive simulations of fate and transport of selenium distribution at the R6 CCR Landfill.

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Tables

Table 1
Calibrated Transport Model Parameters
Plant Yates, George Power
Newnan, Georgia

Model Structure		Transport Model Parameters						
		Adsorption (L/kg)	Porosity		Mass Transfer Coefficient	Dispersivity (ft)		
Hydrostratigraphic Unit	Model Layer		Mobile	Immobile		Longitudinal	Horizontal Transverse	Vertical Transverse
Coal Ash	1	0.20	17%	20%	1.0E-04	10	1	0.1
Saprolite	2	0.20	17%	20%	1.0E-04	10	1	0.1
PWR	3	0.12	10%	15%	1.0E-04	10	1	0.1
Slightly Fractured Bedrock	4	0.00	10%	15%	1.0E-04	10	1	0.1
Upper Deep Bedrock	5	0.00	4%	10%	1.0E-05	10	1	0.1
Lower Deep Bedrock	6	0.00	1%	9%	1.0E-05	10	1	0.1

Notes:
L/kg = Liter per kilogram
ft = feet
PWR = Partially Weathered Rock

Table 2
Historical Transport Model Stress Period Summary
Plant Yates, George Power
Newnan, Georgia

Model Stress Period	Stress Period Type: Flow	Stress Period Type: Transport	Start Date	End Date	Stress Period Length (days)	Cumulative Time (days)	No. of Time Step	R6 Construction Activities
1	Steady State	Transient	1/1/1978	12/31/1984	2557	2557	1	Phase 1 Construction
2	Steady State	Transient	1/1/1985	12/31/1988	1461	4018	1	Phase 2 Construction
3	Steady State	Transient	1/1/1989	2/28/1993	1520	5538	1	Phase 3 Construction
4	Steady State	Transient	3/1/1993	12/31/1996	1402	6940	1	Phase 4 Construction
5	Steady State	Transient	1/1/1997	2/28/1999	789	7729	1	Phase 5 Construction
6	Steady State	Transient	3/1/1999	7/31/2005	2345	10074	1	Vertical Stacking only - no horizontal expansioin
7	Steady State	Transient	8/1/2005	9/14/2014	3332	13406	1	Temporary Cover Installation
8	Steady State	Transient	9/15/2014	10/17/2015	398	13804	1	Permanant Cover Installation - Southern half R6 Landfill
9	Steady State	Transient	10/18/2015	12/31/2016	441	14245	1	Permanant Cover Installation - Northern half R6 Landfill
10	Transient	Transient	1/1/2017	12/31/2017	365	14610	1	Permanant Cover Installation - Complete
11	Transient	Transient	1/1/2018	3/31/2018	90	14700	4	Permanant Cover Installation - Complete
12	Transient	Transient	4/1/2018	6/30/2018	91	14791	4	Permanant Cover Installation - Complete
13	Transient	Transient	7/1/2018	9/30/2018	92	14883	4	Permanant Cover Installation - Complete
14	Transient	Transient	10/1/2018	12/31/2018	92	14975	4	Permanant Cover Installation - Complete
15	Transient	Transient	1/1/2019	3/31/2019	90	15065	4	Permanant Cover Installation - Complete
16	Transient	Transient	4/1/2019	6/30/2019	91	15156	4	Permanant Cover Installation - Complete
17	Transient	Transient	7/1/2019	9/30/2019	92	15248	4	Permanant Cover Installation - Complete
18	Transient	Transient	10/1/2019	12/31/2019	92	15340	4	Permanant Cover Installation - Complete
19	Transient	Transient	1/1/2020	3/31/2020	91	15431	4	Permanant Cover Installation - Complete
20	Transient	Transient	4/1/2020	6/30/2020	91	15522	4	Permanant Cover Installation - Complete
21	Transient	Transient	7/1/2020	9/30/2020	92	15614	4	Permanant Cover Installation - Complete
22	Transient	Transient	10/1/2020	12/31/2020	92	15706	4	Permanant Cover Installation - Complete

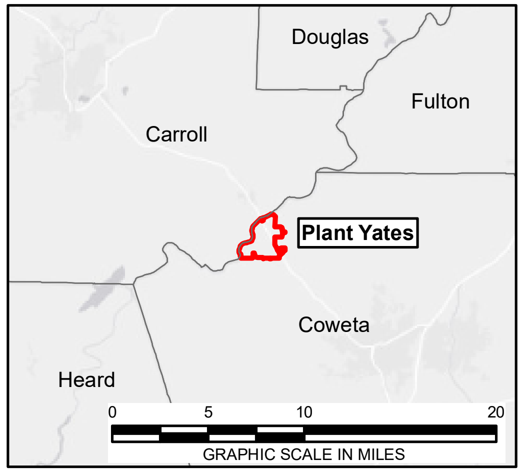
Table 3
Predictive Transport Model Stress Period Summary
Plant Yates, George Power
Newnan, Georgia

ARCADIS

Model Stress Period	Stress Period Type: Flow	Stress Period Type: Transport	Start Date	End Date	Stress Period Length (days)	Cumulative Time (days)	No. of Time Step	Closure Activities (Alternative 1)	Closure Activities (Alternative 2)
1	Transient	Transient	1/1/2021	3/31/2021	90	90	4	DRD Start, Cover Installation for AMA in progress	DRD Start, Cover Installation for AMA in progress
2	Transient	Transient	4/1/2021	6/30/2021	91	181	4	DRD in progress, Cover Installation for AMA in progress	DRD in progress, Cover Installation for AMA in progress
3	Transient	Transient	7/1/2021	9/30/2021	92	273	4	DRD in progress, Cover Installation for AMA in progress	DRD in progress, Cover Installation for AMA in progress
4	Transient	Transient	10/1/2021	12/31/2021	92	365	4	DRD in progress, Cover Installation for AMA in progress	DRD in progress, Cover Installation for AMA in progress
5	Transient	Transient	1/1/2022	3/31/2022	90	455	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
6	Transient	Transient	4/1/2022	6/30/2022	91	546	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
7	Transient	Transient	7/1/2022	9/30/2022	92	638	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
8	Transient	Transient	10/1/2022	12/31/2022	92	730	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
9	Transient	Transient	1/1/2023	3/31/2023	90	820	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
10	Transient	Transient	4/1/2023	6/30/2023	91	911	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
11	Transient	Transient	7/1/2023	9/30/2023	92	1003	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
12	Transient	Transient	10/1/2023	12/31/2023	92	1095	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
13	Transient	Transient	1/1/2024	3/31/2024	91	1186	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
14	Transient	Transient	4/1/2024	6/30/2024	91	1277	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
15	Transient	Transient	7/1/2024	9/30/2024	92	1369	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
16	Transient	Transient	10/1/2024	12/31/2024	92	1461	4	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed
17	Transient	Transient	1/1/2025	12/31/2025	365	1826	12	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed, In-Situ Injection
18	Transient	Transient	1/1/2026	12/31/2050	9131	10957	12	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed	DRD Ends, EM Drain Pumping, Cover Installation for AMA Completed, In-Situ Injection

Notes:
DRD = Dyer Road Dewatering
EM = Engineering Measure
AMA = Ash Management Area
Alternative 1 = Monitored Natural Attenuation
Alternative 2 = In-Situ Injections

Figures



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT BOUNDARY

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 650 1,300 2,600

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

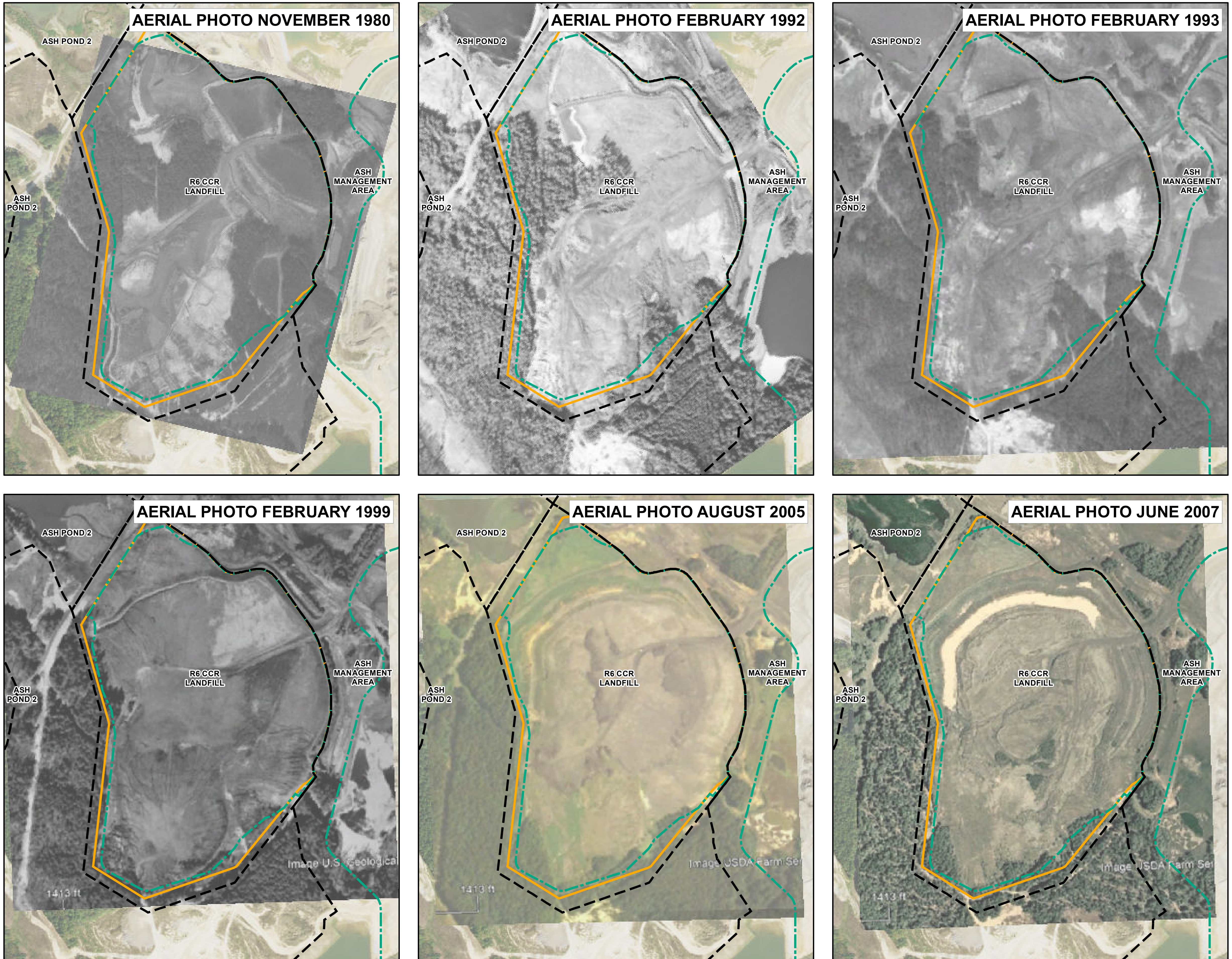
PLANT YATES
NEWNAN, GA

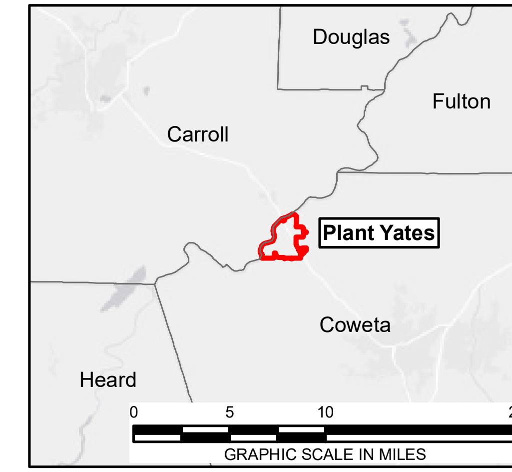
TRANSPORT MODEL REPORT

SITE LOCATION

ARCADIS

FIGURE **1**





LEGEND

EXTENT OF FINAL COVER

PERMITTED UNIT BOUNDARY

R6 WASTE MANAGEMENT BOUNDARY

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 350 700 1,400

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

PLANT YATES
NEWNAN, GA

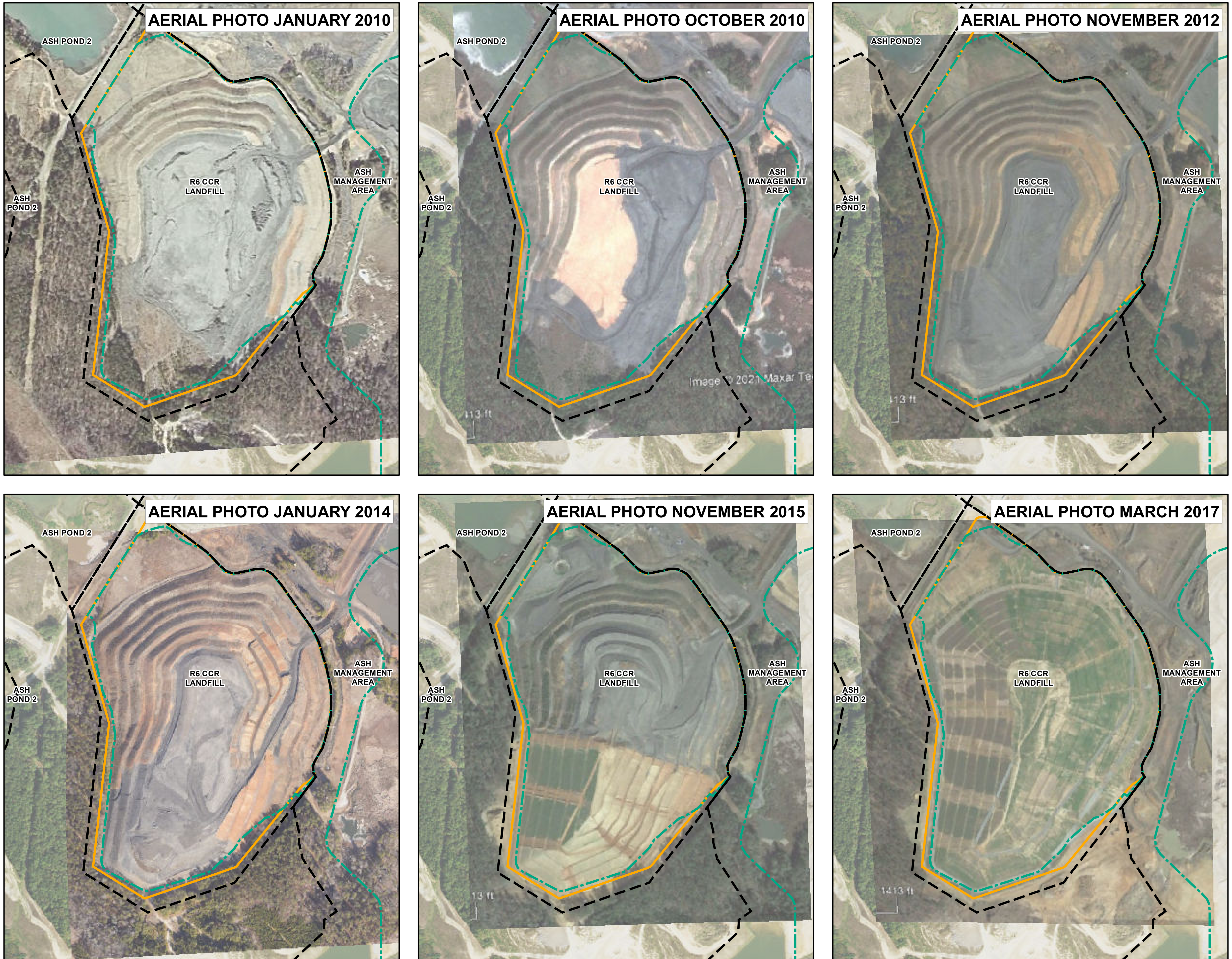
TRANSPORT MODEL REPORT

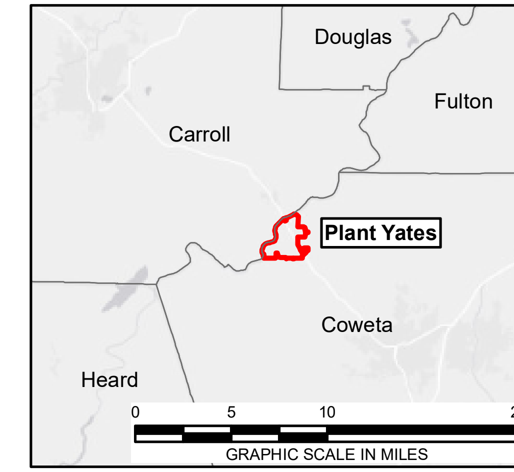
HISTORICAL AERIAL PHOTOS OF R6 CCR LANDFILL

ARCADIS

FIGURE

2A





LEGEND

- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT BOUNDARY

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 350 700 1,400

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

PLANT YATES
NEWNAN, GA

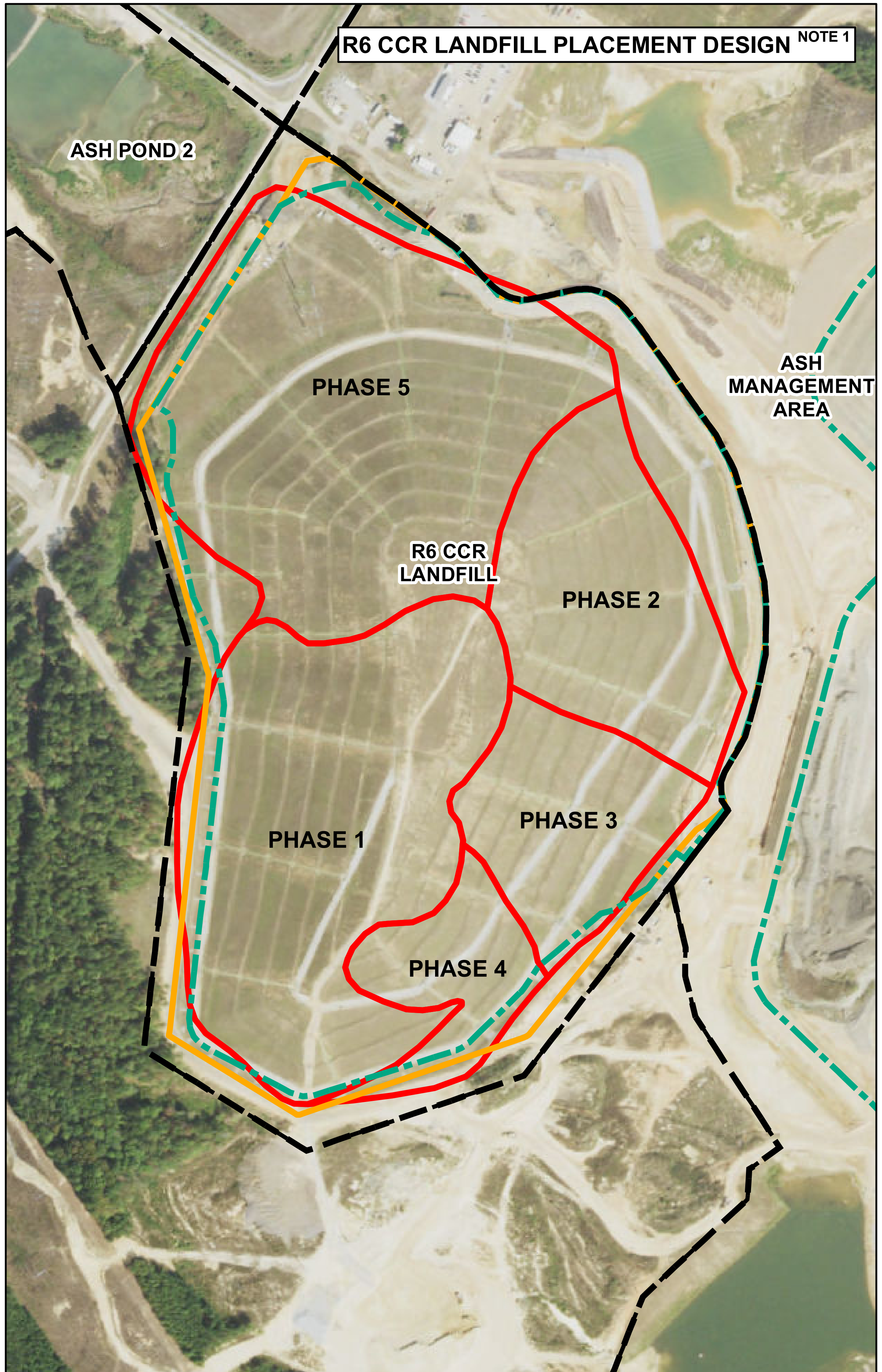
TRANSPORT MODEL REPORT

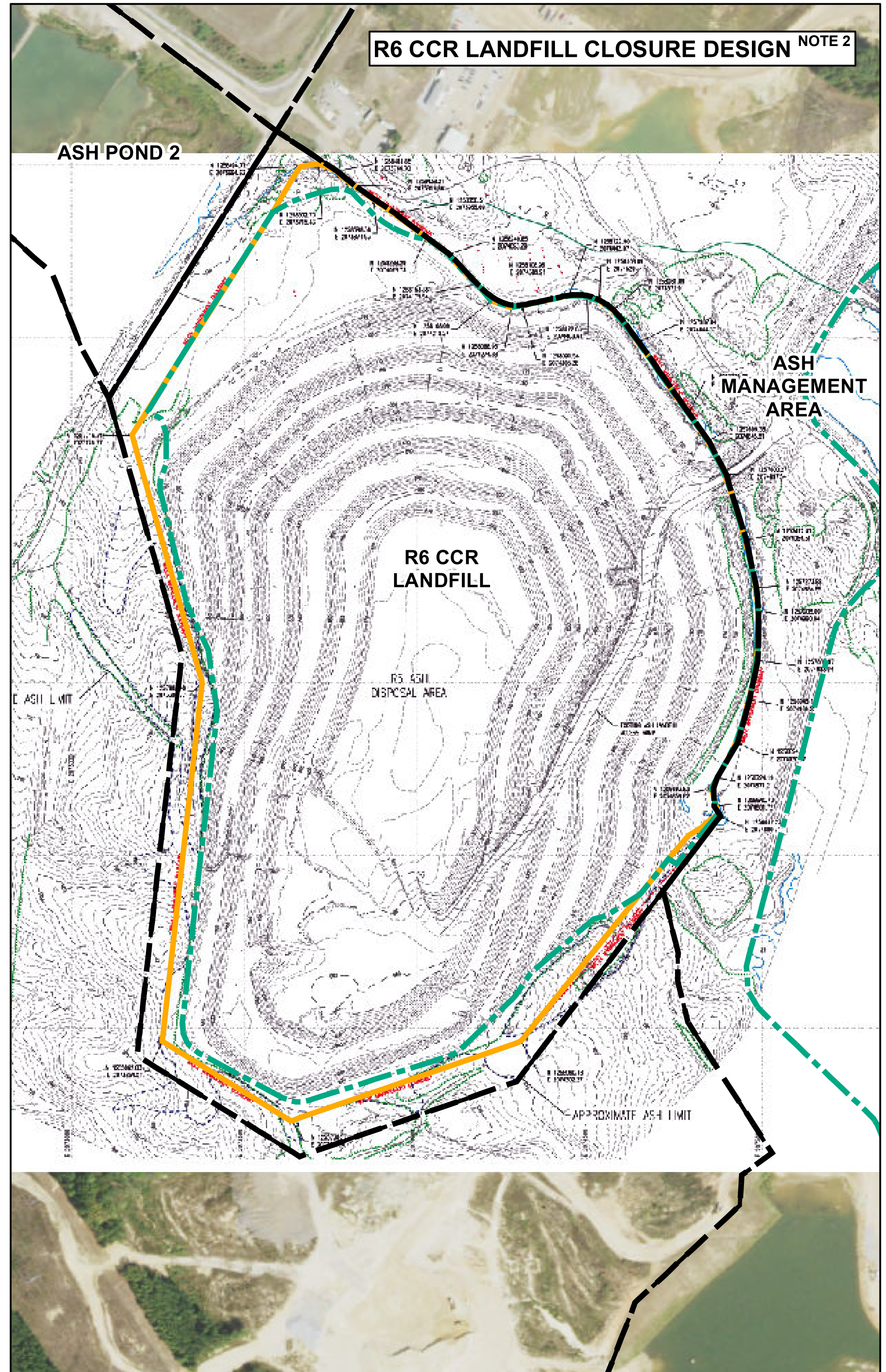
HISTORICAL AERIAL PHOTOS OF R6 CCR LANDFILL

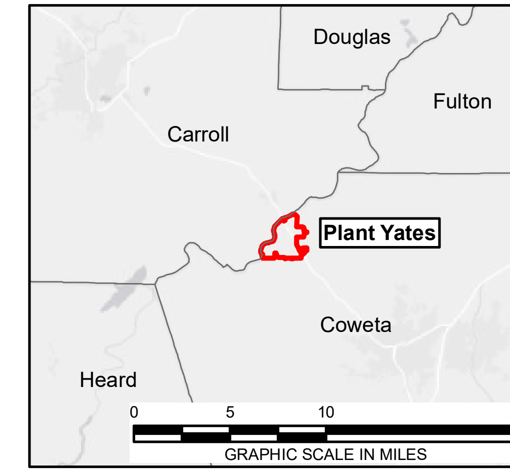
ARCADIS

FIGURE

2B







LEGEND

- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT
- DESIGNED CCR PLACEMENT BOUNDARIES
- CCR COAL COMBUSTION RESIDUALS

NOTES:

1. DATA SOURCE - HENDON ENGINEERING ASSOCIATES, INC., 1984. R-6 FLY ASH LANDFILL, FLY ASH STOCKPILE. DECEMBER, 1984.

2. DATA SOURCE - SOUTHERN COPMANY GENERATION ENGINEERING AND CONSTRUCTION SERVICES FOR GEORGIA POWER COMPANY, 2014. PLANT YATES R6 ASH MONOFILL CLOSURE EXISTING SITE TOPOGRAPHIC MAP. DRAWING NUMBER E16329. PREPARED 5/30/2014.

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 200 400 800
GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

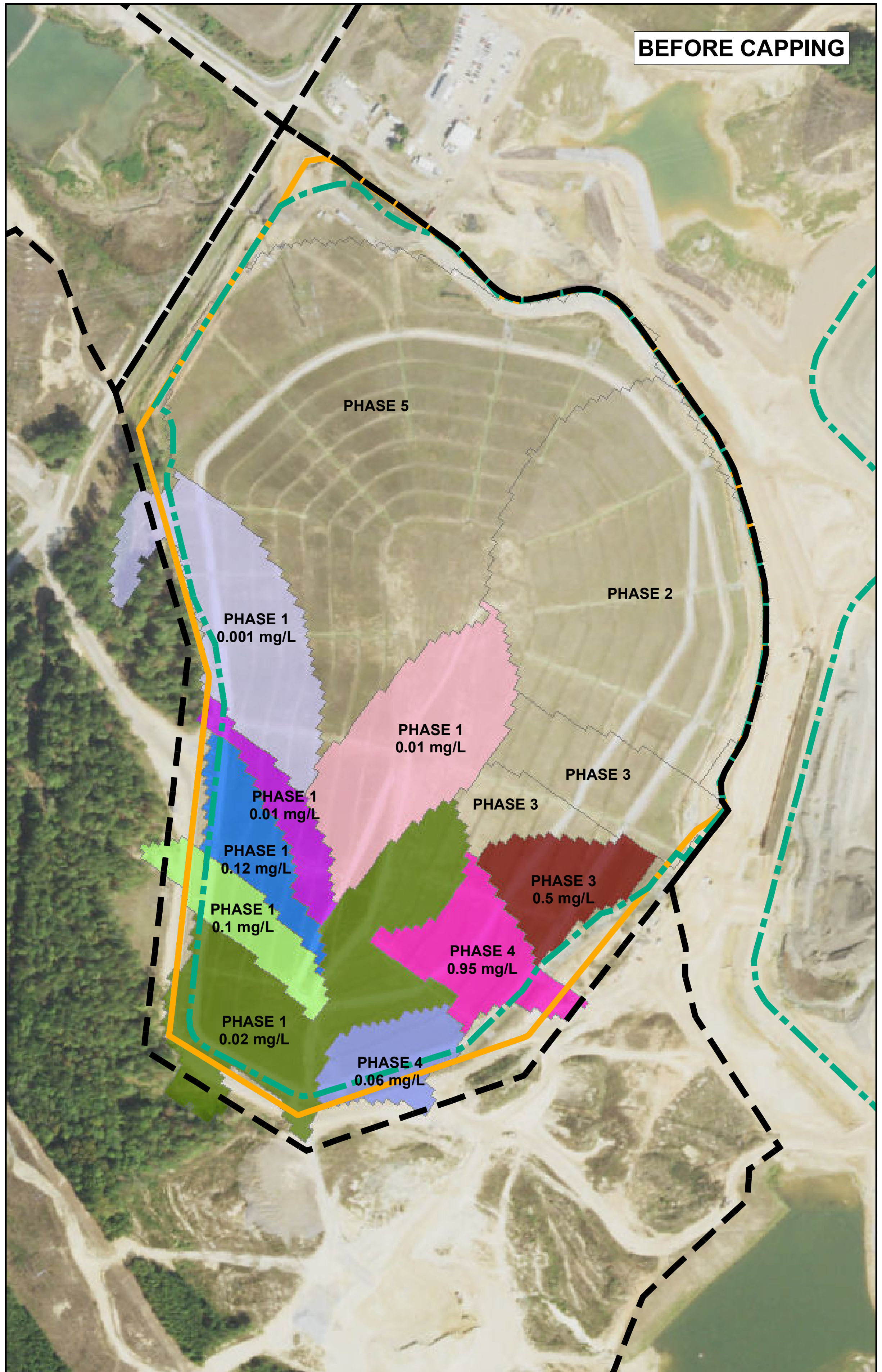
Georgia Power
PLANT YATES
NEWNAN, GA

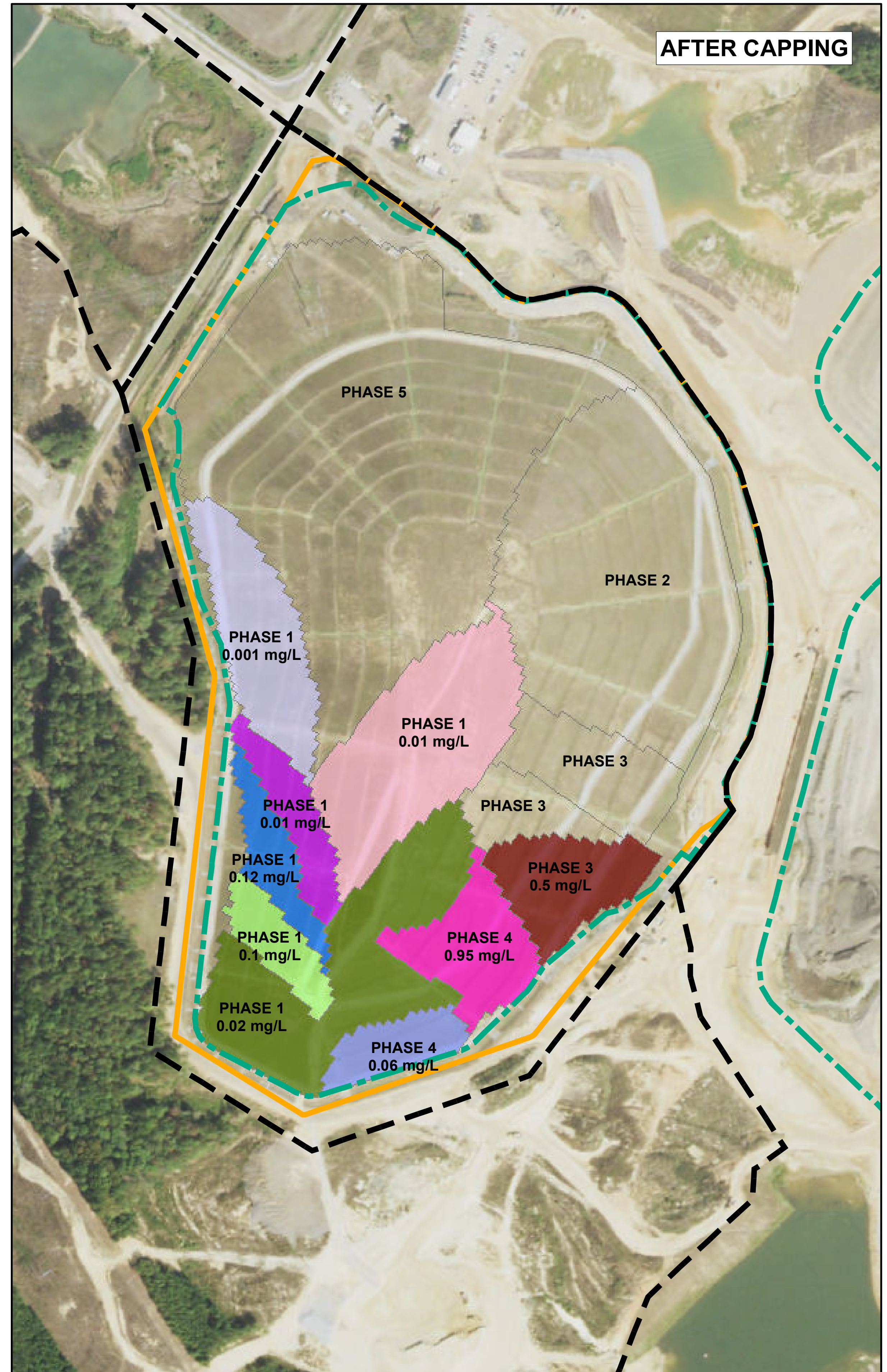
TRANSPORT MODEL REPORT

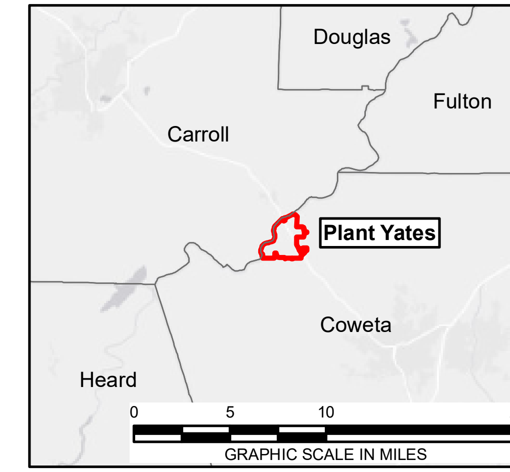
CCR PLACEMENT DESIGN AND CCR CLOSURE DESIGN OF R6 CCR LANDFILL

ARCADIS

FIGURE
2C







LEGEND

- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT BOUNDARY
- PHASE # 0.2 mg/L — SIMULATED SOURCE CONCENTRATION AND SOURCE EXTENT AT DIFFERENT PHASES OF CCR PLACEMENT
- PHASE # — SOURCE CONCENTRATION WAS NOT SIMULATED BECAUSE IT IS NOT SENSITIVE DURING THE TRANSPORT CALIBRATION
- CCR — COAL COMBUSTION RESIDUALS
- mg/L — MILLIGRAM PER LITER

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 200 400 800

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

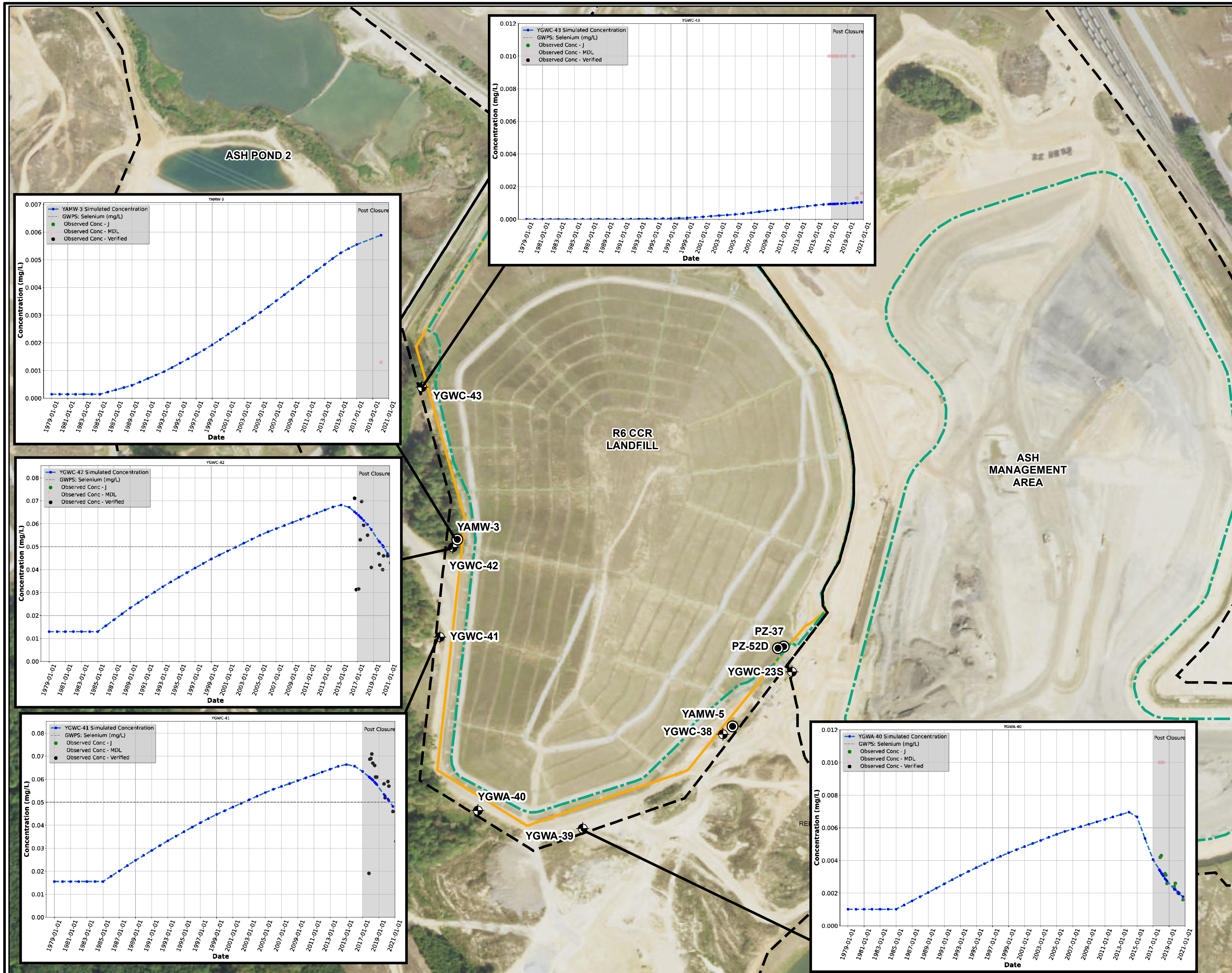
PLANT YATES
NEWNAN, GA

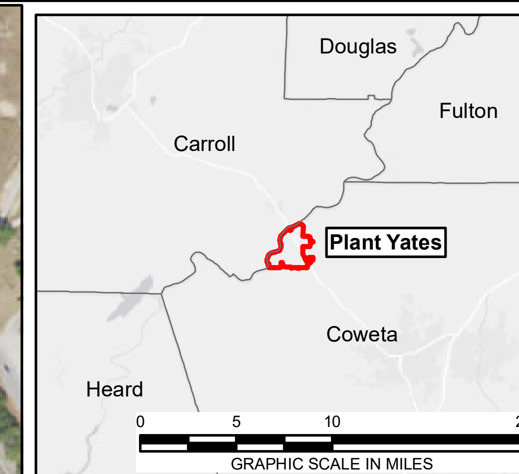
TRANSPORT MODEL REPORT

SIMULATED SOURCE DISTRIBUTION OF SELENIUM (BEFORE CAPPING AND AFTER CAPPING)

ARCADIS

FIGURE
3





LEGEND

- ACTIVE MONITORING WELL LOCATION
- NON-NETWORK WELL/PIEZOMETER
- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT BOUNDARY

MDL METHOD DETECTION LIMIT

GWPS GROUNDWATER PROTECTION STANDARDS

MDL (U) THE ANALYTE WAS NOT DETECTED IN THE SAMPLE ABOVE THE MDL WERE NOT CONSIDERED A VALID CONCENTRATION TARGET VALUE DURING TRANSPORT CALIBRATION

J THE REPORTED VALUE IS ABOVE THE METHOD DETECTION LIMIT (MDL) BUT BELOW THE REPORTING LIMIT WERE SELECTED FOR CONCENTRATION MATCHING

NOTE:

1. OBSERVED SELENIUM CONCENTRATION DATA PRESENTED ON THE GRAPH ARE COLLECTED FROM JUNE 2016 TO DECEMBER 2020

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 200 400 800
GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

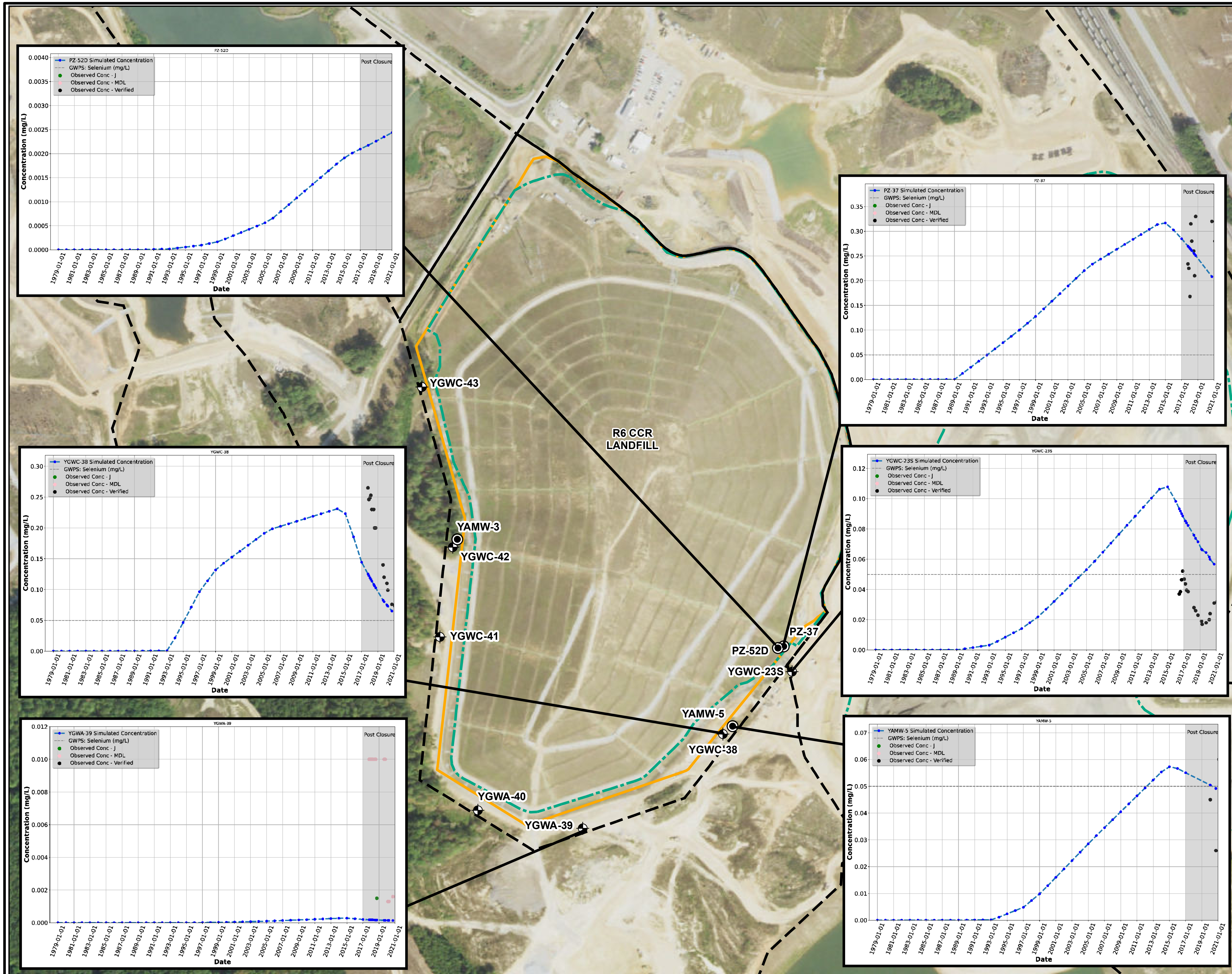
Georgia Power
PLANT YATES
NEWNAN, GA

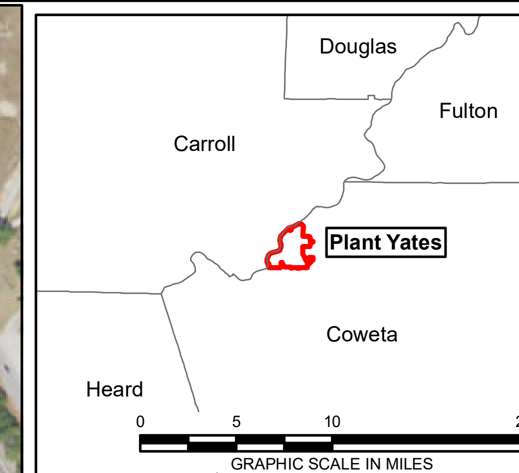
TRANSPORT MODEL REPORT

SIMULATED SELENIUM CONCENTRATION VS OBSERVED SELENIUM CONCENTRATION

ARCADIS

FIGURE
4A





LEGEND

- ACTIVE MONITORING WELL LOCATION
- NON-NETWORK WELL/PIEZOMETER
- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT BOUNDARY

MDL METHOD DETECTION LIMIT

GWPS GROUNDWATER PROTECTION STANDARDS

MDL (U) THE ANALYTE WAS NOT DETECTED IN THE SAMPLE ABOVE THE MDL WERE NOT CONSIDERED A VALID CONCENTRATION TARGET VALUE DURING TRANSPORT CALIBRATION

J THE REPORTED VALUE IS ABOVE THE METHOD DETECTION LIMIT (MDL) BUT BELOW THE REPORTING LIMIT WERE SELECTED FOR CONCENTRATION MATCHING

NOTE:

1. OBSERVED SELENIUM CONCENTRATION DATA PRESENTED ON THE GRAPH ARE COLLECTED FROM JUNE 2016 TO DECEMBER 2020

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

0 200 400 800

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

Georgia Power

PLANT YATES

NEWNAN, GA

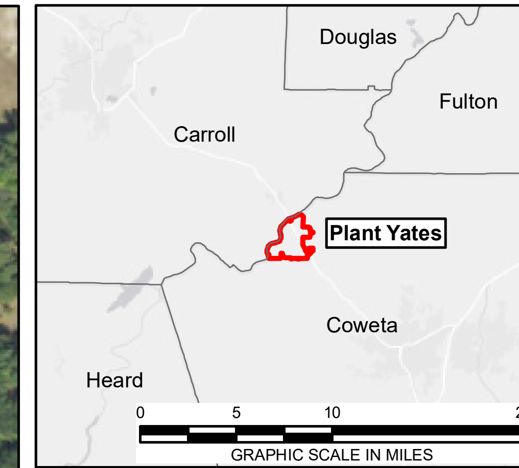
TRANSPORT MODEL REPORT

SIMULATED SELENIUM CONCENTRATION VS OBSERVED SELENIUM CONCENTRATION

ARCADIS

FIGURE

4B



LEGEND

- DYER ROAD DEWATERING WELL TEMPORARILY RUNNING FROM 2020 TO 2021
- INSTALLED CLEANOUT
- INSTALLED PUMP RISER
- DRAIN CELLS WERE USED TO REGULATE THE EXTRACTED FLOWS FROM PUMP RISERS
- ACTIVE MONITORING WELL LOCATION
- NON-NETWORK WELL/PIEZOMETER
- DYER ROAD BARRIER WALL-HORIZONTAL FLOW BARRIER PACKAGE
- ENGINEERING MEASURE DRAIN CONNECTED LINEAR NETWORK PACKAGE
- SURFACE WATER FEATURES-DRAIN PACKAGE
- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT BOUNDARY
- MNA MONITORED NATURAL ATTENUATION

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

N

0 200 400 800

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

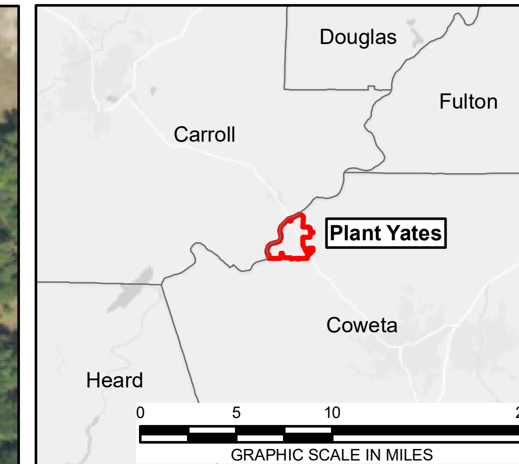
Georgia Power
PLANT YATES
NEWNAN, GA

TRANSPORT MODEL REPORT

PREDICTIVE SCENARIOS DESIGN LAYOUT ALTERNATIVE 1 (MNA)

ARCADIS

FIGURE
5



LEGEND

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- INSTALLED CLEANOUT
- INSTALLED PUMP RISER
- DRAIN CELLS WERE USED TO REGULATE THE EXTRACTED FLOWS FROM PUMP RISERS
- ACTIVE MONITORING WELL LOCATION
- NON-NETWORK WELL/PIEZOMETER
- DYER ROAD BARRIER WALL-HORIZONTAL FLOW BARRIER PACKAGE
- ENGINEERING MEASURE DRAIN CONNECTED LINEAR NETWORK PACKAGE
- IN-SITU ZVI INJECTION - CHEMICAL REACTION ZONE
- SURFACE WATER FEATURES-DRAIN PACKAGE
- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT BOUNDARY

MNA MONITORED NATURAL ATTENUATION

AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

N

0 200 400 800

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

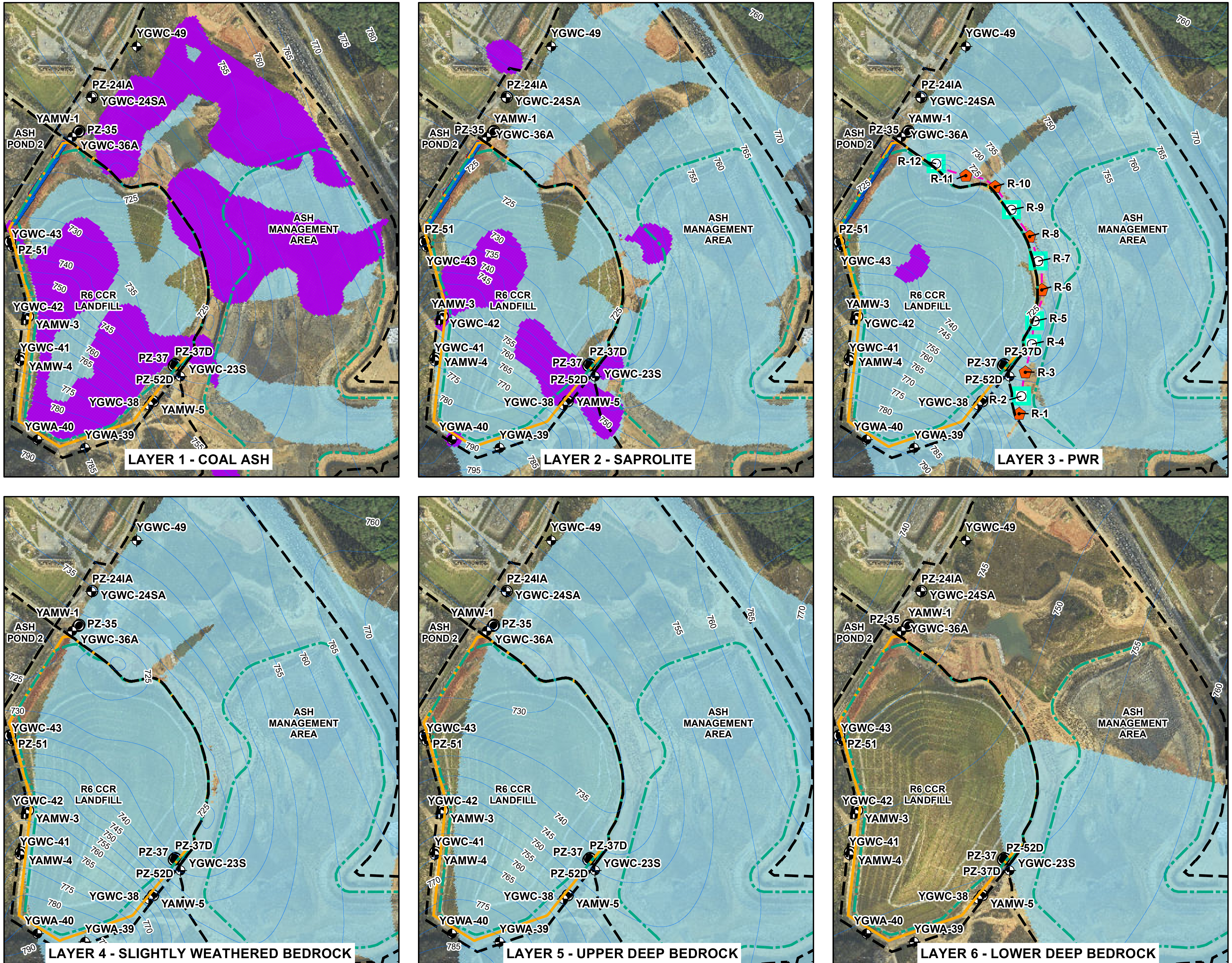
Georgia Power
PLANT YATES
NEWNAN, GA

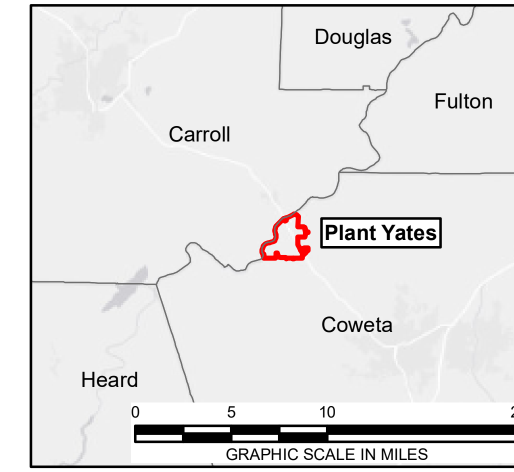
TRANSPORT MODEL REPORT

PREDICTIVE SCENARIOS DESIGN LAYOUT ALTERNATIVE 2 (IN-SITU INJECTION)

ARCADIS

FIGURE
6





LEGEND

- DYER ROAD DEWATERING WELL TEMPORARILY RUNNING FROM 2020 TO 2021
- INSTALLED CLEANOUT
- INSTALLED PUMP RISER
- DRAIN CELLS WERE USED TO REGULATE THE EXTRACTED FLOWS FROM PUMP RISERS
- MONITORING WELL LOCATION
- NON-NETWORK WELL/PIEZOMETER
- DYER ROAD BARRIER WALL-HORIZONTAL FLOW BARRIER PACKAGE
- ENGINEERING MEASURE DRAIN CONNECTED LINEAR NETWORK PACKAGE
- SIMULATED GROUNDWATER ELEVATION CONTOUR
- SIMULATED GROUNDWATER DRY CELL
- SIMULATED GROUNDWATER CAPTURE
- EXTENT OF FINAL COVER
- PERMITTED UNIT BOUNDARY
- R6 WASTE MANAGEMENT BOUNDARY
- MNA MONITORED NATURAL ATTENUATION

AERIAL IMAGE SOURCES: NOVEMBER 11, 2020 IMAGERY FLOWN AND PROCESSED BY SAM LLC; NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.

N

0 450 900 1,800

GRAPHIC SCALE IN FEET

COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET

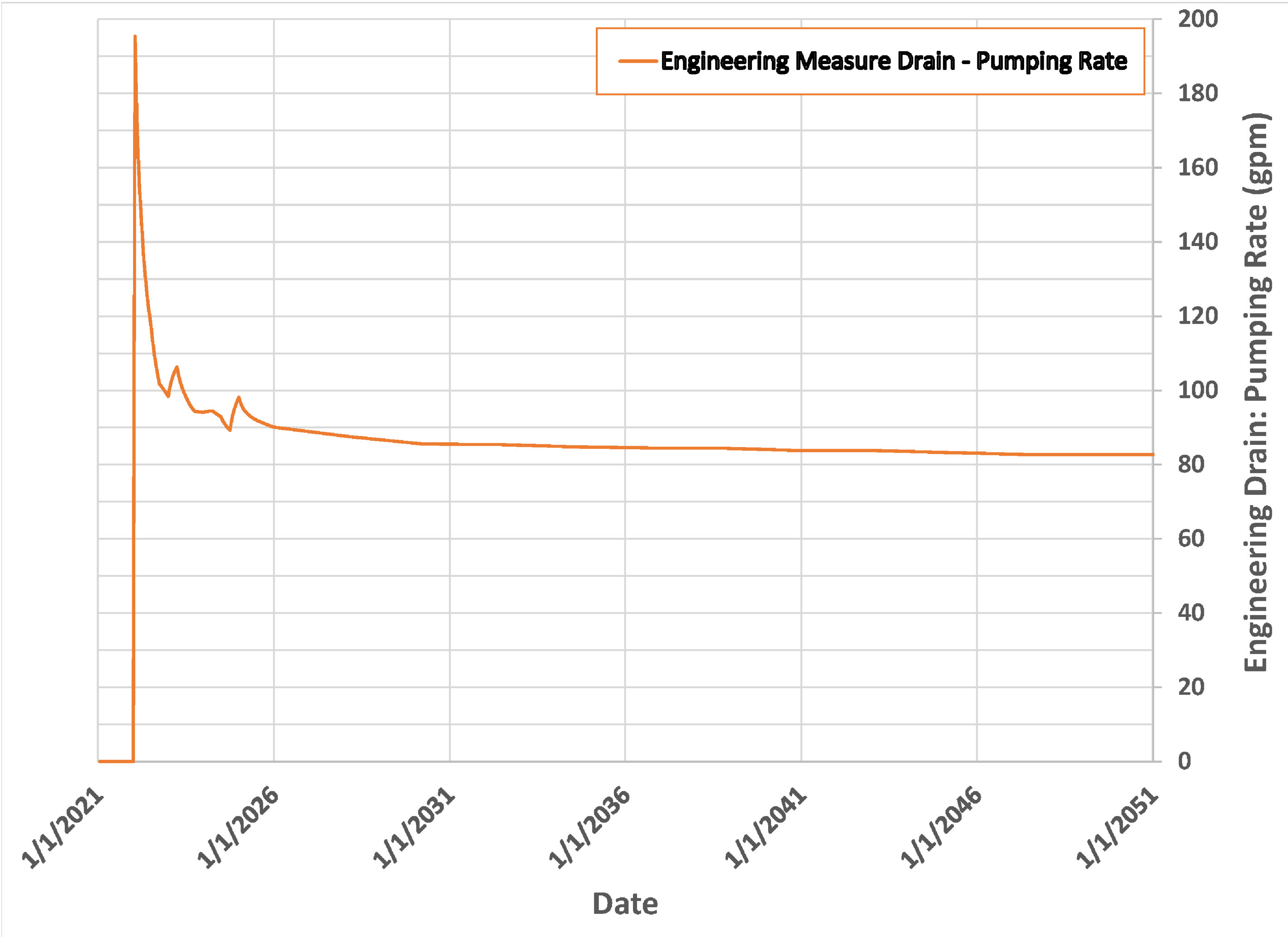
Georgia Power
PLANT YATES
NEWNAN, GA

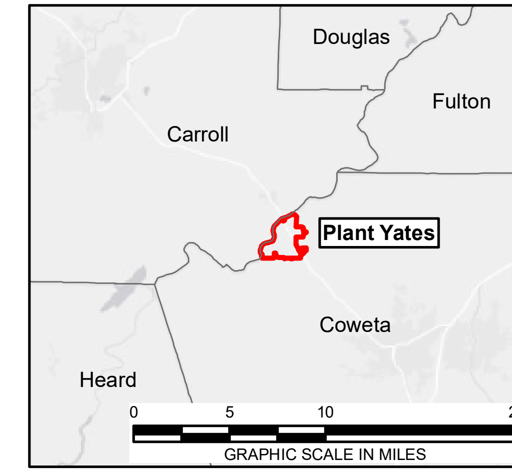
TRANSPORT MODEL REPORT

SIMULATED WATER-LEVEL CONTOURS AND CAPTURE EXTENT OF ALTERNATIVE 1 (MNA)

ARCADIS

FIGURE 7





LEGEND

MNA MONITORED NATURAL ATTENUATION

gpm GALLONS PER MINUTE

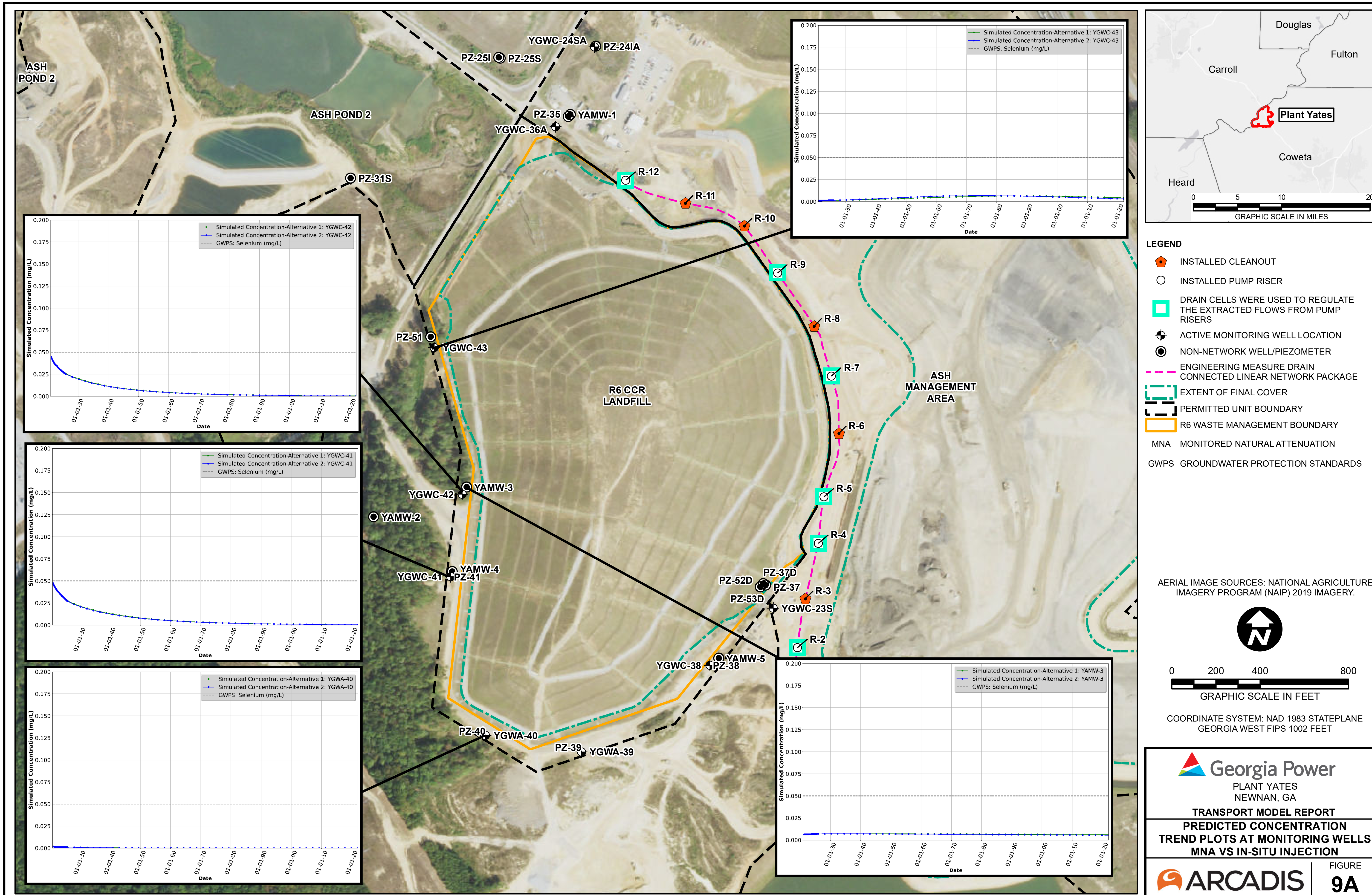
Georgia Power
PLANT YATES
NEWNAN, GA

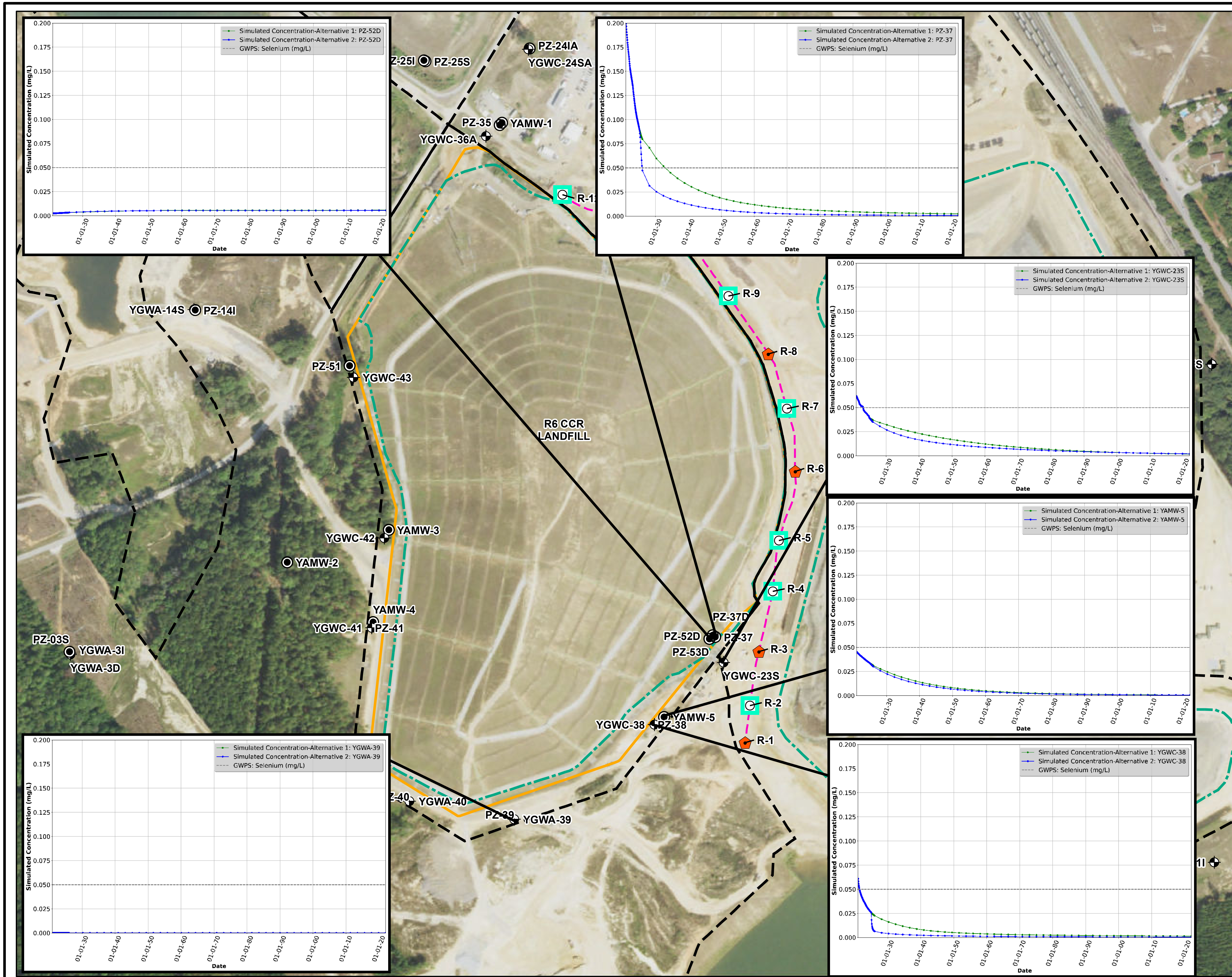
TRANSPORT MODEL REPORT

SIMULATED GROUNDWATER PUMPING RATE OF ALTERNATIVE 1 (MNA)

ARCADIS

FIGURE
8


ASH POND 2
ASH POND 2
YGWC-24SA
PZ-24IA
PZ-25I
PZ-25S
PZ-35
YAMW-1
YGWC-36A
PZ-31S
R-12
R-11
R-10
R-9
R-8
R-7
R-6
R-5
R-4
R-3
R-2
PZ-51
YGWC-43
R6 CCR LANDFILL
ASH MANAGEMENT AREA
YAMW-3
YGWC-42
YAMW-2
YAMW-4
YGWC-41
PZ-41
PZ-52D
PZ-37D
PZ-37
PZ-53D
YGWC-23S
YAMW-5
YGWC-38
PZ-38
PZ-40
YGWA-40
PZ-39
YGWA-39
Simulated Concentration-Alternative 1: YGWC-43
Simulated Concentration-Alternative 2: YGWC-43
GWPS: Selenium (mg/L)
Simulated Concentration-Alternative 1: YGWC-42
Simulated Concentration-Alternative 2: YGWC-42
GWPS: Selenium (mg/L)
Simulated Concentration-Alternative 1: YGWC-41
Simulated Concentration-Alternative 2: YGWC-41
GWPS: Selenium (mg/L)
Simulated Concentration-Alternative 1: YGWA-40
Simulated Concentration-Alternative 2: YGWA-40
GWPS: Selenium (mg/L)
Simulated Concentration-Alternative 1: YAMW-3
Simulated Concentration-Alternative 2: YAMW-3
GWPS: Selenium (mg/L)
Simulated Concentration (mg/L)
Date
Douglas
Fulton
Carroll
Plant Yates
Coweta
Heard
0 5 10 20
GRAPHIC SCALE IN MILES
LEGEND
INSTALLED CLEANOUT
INSTALLED PUMP RISER
DRAIN CELLS WERE USED TO REGULATE THE EXTRACTED FLOWS FROM PUMP RISERS
ACTIVE MONITORING WELL LOCATION
NON-NETWORK WELL/PIEZOMETER
ENGINEERING MEASURE DRAIN CONNECTED LINEAR NETWORK PACKAGE
EXTENT OF FINAL COVER
PERMITTED UNIT BOUNDARY
R6 WASTE MANAGEMENT BOUNDARY
MNA MONITORED NATURAL ATTENUATION
GWPS GROUNDWATER PROTECTION STANDARDS
AERIAL IMAGE SOURCES: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2019 IMAGERY.
0 200 400 800
GRAPHIC SCALE IN FEET
COORDINATE SYSTEM: NAD 1983 STATEPLANE GEORGIA WEST FIPS 1002 FEET
Georgia Power
PLANT YATES
NEWNAN, GA
TRANSPORT MODEL REPORT
PREDICTED CONCENTRATION TREND PLOTS AT MONITORING WELLS MNA VS IN-SITU INJECTION
ARCADIS
FIGURE
9A



Georgia Power
PLANT YATES
NEWNAN, GA

TRANSPORT MODEL REPORT

PREDICTED CONCENTRATION TREND PLOTS AT MONITORING WELLS MNA VS IN-SITU INJECTION

ARCADIS

FIGURE **9B**

Appendix D

Risk Evaluation Report

RISK EVALUATION REPORT

PLANT YATES
R6 CCR LANDFILL AND ASH MANAGEMENT AREA
COWETA COUNTY, GEORGIA

Prepared for

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Prepared by

Wood Environment & Infrastructure Solutions, Inc.
1075 Big Shanty Road NW, #100
Kennesaw, Georgia 30144

Project Number 6123-20-1471

July 2022

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LIST OF ACRONYMS AND ABBREVIATIONS

ACC	Atlantic Coast Consulting
AMA	Ash Management Area
AP	Ash Pond
CCR	Coal Combustion Residual
CEM	Conceptual Exposure Model
CFR	Code of Federal Regulations
COI	Constituent of Interest
COPI	Constituent of Potential Interest
EPC	Exposure Point Concentration
EPD	[Georgia] Environmental Protection Division
ft	feet
ft/day	feet per day
GWPS	Groundwater Protection Standard
HSRA	Hazardous Site Response Act
IRIS	Integrated Risk Information System
K	Hydraulic Conductivity
mg/L	Milligrams per liter
amsl	above mean sea level
ProUCL	ProUCL software version 5.1
PZ	Piezometer
RME	Reasonable Maximum Exposure
RRS	Risk Reduction Standards
RSL	Regional Screening Level
SSL	Statistically Significant Level
UCL	95 Percent Upper Confidence Limit of the Arithmetic Mean
USEPA	United States Environmental Protection Agency
VRP	Voluntary Remediation Program

EXECUTIVE SUMMARY

Georgia Power's Plant Yates (site) is a former seven-unit coal-fired, electric-generating facility approximately 8 miles northwest of Newnan and 13 miles southeast of the city of Carrollton, Georgia in Coweta County, Georgia. Plant Yates began operations in 1982. In compliance with applicable regulations, coal combustion residual (CCR) material resulting from power generation has historically been transferred and stored at the site's CCR units which include the Gypsum Stack Landfill, R6 CCR Landfill (R6), AP-1, AP-2, AP-3, AP-A, AP-B, and AP-B'. The Ash Management Area (AMA) includes the former footprints of ash ponds AP-3, AP-A, AP-B, and AP-B'.

Georgia Power is currently in the permitting process for the closures of R6 and the AMA in place by consolidating the excavated CCR material to a smaller footprint and grading to promote drainage with placement of a final impermeable cover system in accordance with the Federal CCR Rule, 40 Code of Federal Regulations (C.F.R.). § 257[1], and the State CCR Rule, Georgia Environmental Protection Division (EPD) Coal Combustion Residuals Rule 391-3-4-.10. Two permit applications were submitted to Georgia EPD in November 2018: one for the AMA and another for R6. Due to the configuration of the units and overall groundwater flow direction, both permit applications propose combining the monitoring systems of R6 and AMA into a single multi-unit monitoring system that meets federal and state monitoring requirements. The combined monitoring system is hereafter referred to in this report as R6-AMA. Post closure care including semiannual groundwater monitoring and reporting for R6-AMA is required for at least 30 years following closure in place of these units.

This report focuses on R6-AMA and presents the results of a human health risk and ecological evaluation for CCR constituents that exhibit statistically significant levels (SSLs) in groundwater at the site. Note that SSL-related constituents in groundwater were delineated within the plant boundary. Therefore, evaluation of off-site ecological receptors associated with the surface water pathway was not necessary. A conservative, health-protective approach was used that is generally consistent with United States Environmental Protection Agency (USEPA) risk assessment guidance, Georgia EPD regulations and guidance, and standard practice for risk assessment in the State of Georgia. Using the groundwater protection standards (GWPS) established for R6-AMA according to Federal and State CCR Rules, beryllium, and selenium were previously identified as SSL-related constituents (Arcadis, 2022). The risk evaluation relies on recent

[1] The full citation for the Federal CCR Rule is: *Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments,* 40 C.F.R. § 257. The rule was finalized with an effective date of October 14, 2015 and last amended August 28, 2020 with an effective date of September 28, 2020 (USEPA, 2020).

groundwater data collected by Georgia Power in compliance with the Federal and State CCR Rules.

Generally consistent with USEPA guidance, this risk evaluation used a tiered approach to evaluate potential risks, which included the following steps:

1. Development of a conceptual exposure model (CEM) for R6-AMA.
2. Initial groundwater risk screening: Comparison of groundwater concentrations for SSL-related constituents (beryllium and selenium) to conservative, health-protective criteria and/or background concentrations to assess whether constituents pose a risk to human health.
3. Refined groundwater risk evaluation: Performance of a more refined analysis for Constituents of Potential Interest (COPIs) that were retained in the initial risk screening in order to evaluate the potential risks for hypothetical off-site residential receptors exposed to groundwater.
4. Development of risk conclusions and identification of associated uncertainties.

Using this approach that includes multiple conservative assumptions, SSL-related constituents in on-site groundwater monitoring wells were either below the health-protective screening criteria (beryllium) or delineated to concentrations not exceeding health-protective screening criteria on-site (selenium) (i.e., either within R6-AMA or the downgradient AP-2 groundwater monitoring networks). Therefore, no further risk evaluation of groundwater is warranted. Compliance groundwater monitoring for R6-AMA under the Federal and State CCR Rules will continue. Georgia Power will proactively evaluate the data and update this evaluation, if necessary.

1 INTRODUCTION

This report summarizes a risk evaluation of R6-AMA located at Georgia Power's Plant Yates in Coweta County, Georgia (**Figure 1**). R6-AMA is to the east of AP-2 and to the southeast of AP-1. Georgia Power is currently in the permitting process to close R6-AMA in accordance with the Federal CCR Rule (USEPA, 2020), and the State CCR Rule (EPD, 2022). Two permit applications were submitted to the Georgia EPD in November 2018: one for AMA and another for R6. Due to the configuration of the units and overall groundwater flow direction, both permits proposed combining the monitoring systems of AMA and R6 into a single multi-unit monitoring system that meets federal and state monitoring requirements.

This risk evaluation provides additional technical review of the human health and environmental protectiveness associated with R6-AMA with respect to constituent concentrations in groundwater identified at SSLs above the GWPS.

The risk evaluation relies on a conservative, health-protective approach that is generally consistent with the risk approaches outlined in the Voluntary Remediation Program (VRP) (Georgia Voluntary Remediation Act, O.C.G.A. § 12-8-100) (EPD, 2009) and components of the Risk Assessment Guidance for Superfund (RAGS) as included in the USEPA Regional Screening Levels (RSLs) User's Guide (USEPA, 2022a). This evaluation also incorporated principles and assumptions generally consistent with Federal and State CCR Rules.

The risk evaluation includes the development of a site-specific CEM and a stepwise risk screening process for identified SSL-related constituents for R6-AMA. Beryllium and selenium were identified as state and federal SSL-related constituents using the GWPS established for R6-AMA according to Federal and State CCR Rules (Arcadis, 2022). In addition, lithium was a state SSL-related constituent using the GWPS established for R6-AMA according to the State CCR rules. USEPA revised the Federal CCR Rule on July 30, 2018, updating the GWPS for cobalt, lead, lithium, and molybdenum values. On February 22, 2022, EPD adopted the federal GWPS for cobalt, molybdenum, lithium, and lead under 40 CFR §257.95(h) (EPD, 2022), which established the GWPS for these constituents as the higher of background concentrations or 0.006 mg/L, 0.10 mg/L, 0.040 mg/L, and 0.015 mg/L, respectively.

Because of this, lithium is no longer considered a state SSL-related constituent, and as such is not evaluated in this report.

Beryllium was identified as an SSL-related constituent in YGWC-38 and selenium in YGWC-38 and PZ-37 for R6 (**Figure 2**). Beryllium and cobalt were also previously identified as SSL-related constituents in YGWC-33S for AMA (**Figure 2**). Beryllium and cobalt present at YGWC-33S have been delineated by downgradient wells within the permitted unit boundary for AMA (Arcadis, 2022). YGWC-33S was subsequently abandoned in June 2020 because it was installed within the permitted boundary and, therefore, not best located to detect groundwater flow at the waste boundary of the AMA. There are no SSLs for cobalt in the remaining monitoring well network for AMA requiring corrective action (Arcadis, 2022). Accordingly, consideration of cobalt in this risk evaluation is not warranted. Based on the results of the risk evaluation for beryllium and selenium, a site-specific recommended path forward is provided.

The remainder of the report is organized as follows:

- ***Section 2, Basis and Background for the Development of the Conceptual Exposure Model*** – Presents site-specific information related to the site history, monitoring network, topography and surface hydrology, geology and hydrogeology, potential transport pathways, and receptors that could potentially be exposed to SSL-related constituents.

- ***Section 3, Risk Evaluation Screening*** – Describes the process for the initial risk-based screening of SSL-related constituents to identify COPIs in groundwater.

- ***Section 4, Refined Risk Evaluation*** **–** Describes the risk screening process for the groundwater COPIs, including calculation of exposure point concentrations (EPCs) and analysis of concentration trends over time.

- ***Section 5, Uncertainty Assessment*** **–** Describes the uncertainties associated with the risk screening process.

- ***Section 6, Conclusions*** – Presents the conclusions of the risk evaluation.

- ***Section 7, References*** – Provides reference information for the sources cited in this document.

2 BASIS AND BACKGROUND FOR THE DEVELOPMENT OF THE CONCEPTUAL EXPOSURE MODEL

This section provides a brief overview of the site location and operational history, site regulatory status, and geology/hydrogeology.

A CEM representing the site-specific processes and conditions that are relevant to the potential migration of groundwater and potential exposure to SSL-related constituents has been developed based on a review and compilation of information previously presented for R6-AMA, including the *Hydrogeologic Assessment Report* (ACC, 2020) and *2021 Annual Groundwater Monitoring and Corrective Action Report* (Arcadis, 2022). The CEM includes a conservative evaluation of potential exposure pathways, and potential human and ecological receptors.

2.1 Site Description

Plant Yates is located on the east bank of the Chattahoochee River in Coweta County, Georgia near the Coweta and Carroll County line, approximately 8 miles northwest of the city of Newnan and 13 miles southeast of the city of Carrollton. Plant Yates occupies approximately 2,400 acres and is bordered by the Chattahoochee River on the west (**Figure 1**). Plant Yates was once a coal-fired power generating facility but was converted to natural gas combustion turbines in 2014. Of the original seven coal-fired steam generating units (Units 1 – 7), Units 1 through 5 were retired in 2015 and Units 6 and 7 were converted from coal to natural gas and remain in service. CCR units at Plant Yates include the Gypsum Stack Landfill, AP-1, AP-2, and R6-AMA. The units included in R6-AMA for this report are described below (ACC, 2020):

- R6 is an inactive CCR landfill as defined in the Georgia Rules for Solid Waste Management, Rule 391-3-4-.10(2)(a)3, because it no longer received CCR on or after October 19, 2015. R6 will be closed in place in accordance with the solid waste permit and the CCR Rules.

- Once consolidated and closed in place, the AMA will consist of CCR from AP-1, AP-2, AP-3, AP-A, AP-B, and AP-B'. AP-1 was a 23.4-acre CCR surface impoundment that completed closure by removal in July 2017. AP-2 is an inactive 60-acre CCR surface impoundment currently undergoing closure by removal. AP-3 is an inactive 55-acre surface impoundment currently undergoing closure in place including consolidation to reduce the footprint. AP-A is a 8.9-acre CCR surface impoundment that completed closure by removal in June 2017. AP-B is an inactive 6.3-acre CCR surface impoundment currently undergoing closure by removal. AP-B' is an inactive 29.8-acre surface impoundment currently undergoing closure in place including consolidation to reduce the footprint.

Semiannual groundwater monitoring and reporting for Plant Yates R6-AMA is performed in accordance with the monitoring program requirements of the Federal CCR Rule and Georgia EPD Solid Waste Management Program. In accordance with 40 CFR § 257.91, a certified compliance groundwater monitoring network was installed to monitor groundwater quality both upgradient and downgradient of R6-AMA. There are also non-network wells/piezometers that may be utilized for water level measurements or non-routine sample collection. The two AP-2 wells farthest downgradient of R6-AMA (YGWC-26S and YGWC-26I) were included in the risk evaluation because groundwater flows from R6-AMA into AP-2 and through the area near YGWC-26S and YGWC-26I, as discussed in Section 2.1.2. The locations of the certified compliance well network, non-network wells/piezometers, and the additional wells included in the risk evaluation are provided on **Figure 2**.

2.1.1 Topography and Surface Hydrology

The site is located within the Piedmont Physiographic Province of central Georgia, which is characterized by gently rolling hills and narrow valleys, with locally pronounced linear ridges. R6-AMA is located within the Middle Chattahoochee River Basin, where annual average rainfall ranges from 50 to 54 inches per year. Topography drops from an elevation of approximately 830 feet (ft) above mean sea level (amsl) along the southeastern border of the site to 700 ft amsl adjacent to the Chattahoochee River located west of R6-AMA. This drop occurs over a distance of approximately 8,300 ft and does not take into account the elevation variations across the site due to manmade features (i.e., CCR units). The Chattahoochee River is a southward flowing river that originates in the Valley and Ridge Physiographic Province near Helen, Georgia.

2.1.2 Geology and Hydrogeology

The geologic and hydrogeologic characteristics of the site have been extensively evaluated and compiled in previous reports. The following presents a brief summary of this information from the *2021 Annual Groundwater Monitoring and Corrective Action Report* (Arcadis, 2022) for R6-AMA:

> *Plant Yates is located in the Inner Piedmont Physiographic Province of western Georgia, immediately southeast of the Brevard Zone, a regional fault zone that separates the Piedmont from the Blue Ridge. Rock units at Plant Yates are primarily interlayered gneiss and schists. The rocks in the area have been subjected to extensive metamorphism, deformation, and igneous intrusions. Extensive fracture sets are present in the underlying bedrock. Surface expressions of these fractures are observed on topographic maps and aerial photographs of the Plant Yates area (ACC, 2020).*
>
> *A thin layer of soil from 1 to 2 feet thick overlies a thick layer of saprolite. The saprolite, which extends to typical depths of 20 to 40 feet below ground surface, was*

formed in-place by the physical and chemical weathering of the underlying metamorphic rocks. The saprolite typically consists of clay- and silt-rich soils that grade to sandier soils with depth. A zone of variable thickness (approximately 5 to 20 feet) of transitionally weathered rock typically exists between the saprolite and competent bedrock. The lithology of the transition zone is highly variable and ranges from medium to coarse unconsolidated material to highly fractured and weathered rock fragments. Localized alluvial soils consisting of generally coarser material (silty-sand, clayey silt, and silty clay with well rounded gravel and cobbles) that have been observed in saprolite may be related to historical river channel migration.

At Plant Yates, groundwater is typically encountered slightly above the saprolite/weathered rock interface. Groundwater flow in the saprolite zone is through interconnected pores and relict textures and fractures. As the rock becomes increasingly competent with depth, groundwater flow occurs mainly through joints and fractures (i.e., secondary porosity). Recharge to the water-bearing zones in fractured bedrock takes place by seepage through the overlying mantle of soil/saprolite or by direct entrance through openings in outcrops and varies with topography. The water table occurs in the saprolite and in the transitionally weathered zone, at least several feet above the top of rock.

Field hydraulic conductivity tests (i.e., slug tests) have been performed in saprolite and weathered bedrock at multiple locations at the site. The hydraulic conductivity at these locations typically ranges from 10^{-3} to 10^{-4} centimeters per second, based on multiple rising-head and falling-head slug tests (ACC, 2019). This indicates a fairly uniform medium across the saprolite and weathered rock horizon. The hydraulic conductivity values from the field tests fall within a range consistent with that of Piedmont overburden (Newell et al., 1990).

The potentiometric surface elevation contours for February 2022 are presented in **Figure 3**. Pertinent hydrogeologic information from the *Hydrogeologic Assessment Report* (ACC, 2020) is presented below:

Groundwater flow in the upper aquifer is under unconfined conditions and the water table is typically noted in the saprolite near the bedrock interface. Deeper groundwater flow is within the fractured bedrock and along discontinuities.

Groundwater flow direction in the upper aquifer is controlled by topography and by drainage features and man-made surface impoundments. The general site-wide groundwater flow direction is from the east-to west with localized flow direction controlled by surface water bodies. Groundwater flow within the multi-unit R6-AMA in the uppermost aquifer is from three directions; south to north, southeast to northwest and east to west. These three flow directions are controlled somewhat by the former surface water drainage swale that meandered from the southeast corner *of the site, around the southeast and south corners of the AMA and between the AMA and R6.*

Groundwater flow across the R6-AMA area ultimately flows west-northwest as it leaves the R6-AMA area and flows into the area surrounding AP-2. Based on the depression formed by the interpreted 710-foot contour line shown on **Figure 3**, groundwater from R6-AMA is anticipated to flow west-northwest towards the river and funnel through the area near YGWC-26S and YGWC-26I.

2.2 Potential Transport Pathways

A variety of geologic, hydrogeologic, and geochemical mechanisms can occur in the subsurface and serve to attenuate constituent concentrations in groundwater such as soil or rock characteristics, the local geology and hydrogeology, and the distance the groundwater must travel before reaching a potential receptor. A summary of potential transport pathways is shown on the CEM in **Figure 4**.

The Chattahoochee River is located to the west of the site and flows in a southward direction (**Figure 2**). SSL-related constituent concentrations in groundwater were either below the health-protective screening criteria (beryllium) or were delineated below health-protective screening criteria in on-site groundwater (selenium); therefore, evaluation of the surface water pathway was not necessary.

2.3 Potential Exposure Pathways and Receptors

The exposure pathways for groundwater assumed to be complete based on site-specific information were used to identify potential receptors and estimate potential risk. The CEM (**Figure 4)** depicts the conservative potential exposure pathways and receptors included in the risk evaluation.

The following potential exposure pathways and receptors were considered:

- On-site industrial worker: The groundwater exposure pathway for the on-site industrial worker was considered incomplete because there are no wells on-site that are classified for use as potable wells.

- On-site construction worker: While there is a potential for limited exposure to groundwater by a construction worker through dermal contact with on-site shallow groundwater during subsurface activities, construction workers would be expected to have little to no direct contact with on-site groundwater due to safety procedures outlined in their site-specific health and safety plans.

- On-site resident: The groundwater exposure pathway for on-site residents was considered incomplete because there is no residential use on-site under current site conditions. Future residential use of the permitted R6-AMA is precluded during post-closure care. Land use surrounding the site is zoned Rural Conservation District (Coweta County, 2020). Beyond the Chattahoochee River to the west, land use is predominantly zoned Industrial and Agricultural with some scattered Residential land use also present (Carroll County, 2021).

- Off-site industrial/construction worker: The potential for off-site worker exposure through direct contact with groundwater was addressed through the evaluation of hypothetical off-site residential receptors. Health-protective screening levels for residential receptors would be more conservative than industrial and construction worker screening levels.

- Off-site resident: The groundwater exposure pathway for hypothetical off-site residential receptors was assumed potentially complete. A well survey of potential groundwater wells within a three-mile radius of R6-AMA was conducted and consisted of reviewing federal, state, and county records and online sources, in addition to conducting a windshield survey of the area (Newfields, 2020). Results of the survey are presented on **Figure 5**. In addition, three wells found west of the Chattahoochee River that were identified in the *2021 Annual Groundwater Monitoring and Corrective Action Report* (Arcadis, 2022) were also included on **Figure 5**. The well survey is included as **Appendix A**. Combining well information from all sources with parcel data, 728 total parcels likely to be associated with an active or inactive private well within the three-mile radius were identified. Although water lines near the site were constructed in the mid-1990s, there are likely homes near water lines that may still be on wells. The survey identified several private wells in the vicinity of the site with the closest being:

    - South of the site and near the southeast corner of AP-3 near Wagers Mill Road, up to Sol Bridges Rodd (upgradient of the site);
    - East of AP-B' near Stapler Road (upgradient of the site);
    - Southeast and northeast (upgradient of the site) along Old Carrollton Road, Sewell Mill Road and Daniel Road; and
    - West of the Chattahoochee River (upgradient of the site and up to 2 miles away).

    No private wells are located downgradient of R6-AMA prior to reaching the Chattahoochee River which is considered a hydraulic discharge boundary. In addition, SSL-related constituent concentrations were either below the health-protective screening criteria (beryllium) or were delineated below health-protective screening criteria in on-site groundwater (selenium) prior to reaching the Chattahoochee River.

    Two public wells are also located within the three-mile radius. These wells, operated by the City of Whitesburg, are located approximately three miles northwest of the site across the Chattahoochee River. Because the Chattahoochee River serves as the site and regional hydraulic discharge boundary for groundwater flow in the upper aquifer, groundwater flow on the west side of the river flows from the north and west to the Chattahoochee River, and is therefore, upgradient of the site.

No surface water intakes have been identified for public water supplies within a three-mile radius of the site. Use of surface water as a drinking water source within three miles of the site is an incomplete exposure pathway; therefore, drinking water exposure assumptions for surface water do not apply.

SSL-related constituent concentrations in on-site groundwater monitoring wells were either below the health-protective screening criteria or delineated to concentrations below health-protective screening criteria on-site (i.e., either within R6-AMA or the downgradient AP-2 groundwater monitoring networks). As a conservative measure, potential off-site residential exposure to SSL-related constituents was evaluated using on-site groundwater wells/piezometers downgradient of R6-AMA and the farthest downgradient wells in AP-2. This comparison makes the conservative assumption that on-site groundwater may potentially migrate to off-site drinking water wells, through advective transport in groundwater without any attenuation within the aquifer media through factors such as dilution, dispersion, or adsorption. The risk evaluation screening conservatively assumed that hypothetical off-site residential receptors could be exposed to the concentrations of SSL-related constituents in groundwater through its use as a potable water supply by ingestion and dermal contact with groundwater.

- Off-site recreational surface water receptors: The surface water exposure pathway for recreational receptors was addressed qualitatively through the evaluation of on-site groundwater data. SSL-related constituent concentrations were either below the health-protective screening criteria (beryllium) or were delineated below health-protective screening criteria in on-site groundwater (selenium); therefore, evaluation of the surface water pathway was not necessary.

- Off-site ecological surface water receptors: The surface water exposure pathway for off-site ecological receptors was addressed qualitatively through the evaluation of on-site groundwater data. SSL-related constituent concentrations were either below the health-protective screening criteria (beryllium) or were delineated below health-protective screening criteria in on-site groundwater (selenium); therefore, evaluation of the surface water pathway was not necessary.

3 RISK EVALUATION SCREENING

The CEM developed in Section 2 was used to identify the potentially complete exposure pathways to human receptors that are considered in the risk evaluation. The initial step in the risk evaluation is the comparison of SSL-related constituents in groundwater to health-protective levels for potentially complete exposure pathways. The approach used is generally consistent with the Georgia EPD regulations and guidance, USEPA guidance, and standard practice for risk assessment in the State of Georgia. The Georgia EPD allows for the site-specific evaluation of risk in programs such as the Voluntary Remediation Program (EPD, 2009).

The initial risk evaluation screening was performed for the potential groundwater exposure pathway by comparing the concentrations of on-site groundwater wells determined to have SSL-related constituents to appropriate health-protective screening criteria. These criteria included the risk reduction standards (RRS) established in accordance with the Hazardous Site Response Act (HSRA)[2] for drinking water and site-specific background for the protection of human health. If the maximum concentration of an SSL-related constituent exceeded the screening criterion, the constituent was identified as a COPI for further evaluation in the refined risk evaluation. The methodology and screening criteria used were identified in accordance with regulatory guidance and standard risk assessment practices using an approach designed to conservatively overestimate possible exposures and risks, providing an additional level of confidence in the conclusions. The methodology is summarized on **Figure 6** and discussed in more detail below.

3.1 Data Used in Risk Evaluation Screening

This section provides information on the groundwater dataset used in the risk evaluation screening.

3.1.1 Groundwater Data

For the initial risk screening evaluation, groundwater data from samples collected between 2017 and February 2022 from the on-site wells that were identified to have SSL-related constituents were used in the risk screening evaluation for hypothetical off-site residential exposure. The wells that were previously identified to have SSL-related constituents under the Federal and State CCR Rules include YGWC-38 for beryllium and YGWC-38 and PZ-37 for selenium. Data from these wells for the SSL-related constituents were screened against relevant health-protective screening criteria. The wells with SSL-related constituents are depicted on **Figure 2** and the groundwater dataset used for wells exhibiting SSLs in the risk evaluation is presented in **Appendix B.** Method

[2] HSRA and the VRP were updated in 2018 for consistency with USEPA's RAGS for the calculation of RSLs.

detection limits for the groundwater dataset used in the risk evaluation were reviewed and confirmed to be less than the screening levels. All groundwater data were validated in accordance with USEPA guidance.

3.1.2 Background Groundwater Quality

Statistical analysis of groundwater monitoring data is performed at Plant Yates pursuant to §257.93-95 following the professional engineer (PE)-certified Statistical Analysis Method Certification (Rev 01, amended January 2020) (Georgia Power, 2020) for R6-AMA and the Unified Guidance (USEPA, 2009); background values are routinely updated under the program. Nineteen monitoring wells in the certified monitoring well network were designated as upgradient or background locations, including YGWA-4I, YGWA-5D, YGWA-5I, YGWA-17S, YGWA-18S, YGWA-18I, YGWA-20S, YGWA-21I, YGWA-39, YGWA-40, YGWA-1I, YGWA-1D, YGWA-2I, YGWA-3I, YGWA-3D, YGWA-14S, YGWA30I, YGWA-47, and GWA-2. The statistical analyses performed on the groundwater data using Sanitas groundwater statistical software, as described in the *2021 Annual Groundwater Monitoring and Corrective Action Report* (Arcadis, 2022), as presented below:

> *Interwell parametric tolerance limits were used to calculate background limits from pooled upgradient well data for the wells identified in Table 1A for Appendix IV constituents with a target of 95 percent confidence and 95 percent coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. The background levels are then used when determining the groundwater protection standards (GWPS) in accordance with 40 CFR § 257.95(h) and GAEPD Rule 391-3-4-.10(6)(a).*

Naturally occurring or site-specific background concentrations can exceed health-protective screening criteria. Therefore, site-specific background values may be used as the groundwater screening values if background concentrations were identified as greater than the groundwater screening values.

3.2 Groundwater Screening Evaluation

The process of screening SSL-related constituents in groundwater against human health screening levels for groundwater is discussed below and presented in **Figure 6**. The HSRA RRS evaluated under the VRP approach presented herein included Type 1 and Type 2 standards for off-site residential receptors. The Hazardous Site Response Act, Rule 391-3-19.07(1) notes that "*[a]ll risk reduction standards will, when implemented, provide adequate protection of human health and the environment.*" In addition, Rule 391-3-19.07(3) notes a corrective action, if needed, may be considered complete when "*a site meets any or a combination of the applicable risk reduction standards described in Rule 391-3-19-.07.*"

In accordance with standard practice and methodologies approved by the Georgia EPD, the screening level hierarchy for the SSL-related constituents is as follows:

- The higher of the Type 1 or Type 2 RRS for potential future off-site residential exposures, which are considered protective of human health for those constituents regulated under HSRA (i.e., beryllium and selenium).

  Type 2 RRSs were used for beryllium and selenium, which are the lower of the calculated carcinogenic and non-carcinogenic values derived using the default exposure factors for residential receptors and the methodology found in Appendix III of the HSRA rule (EPD, 2018). Toxicity values for beryllium and selenium used for the Type 2 RRS calculations were identified in the Integrated Risk Information System (IRIS) (USEPA, 2022b). The risk-based Type 2 RRS were calculated using USEPA's RSL calculator (USEPA, 2022a) assuming a target cancer risk of 1×10^{-5} and a target hazard quotient of 1, consistent with Georgia EPD guidance (EPD, 2018). The calculations of the Type 2 RRS values for the SSL-related constituents are presented in **Appendix C**.

- If site-specific background concentrations are greater than the criteria described above, then the site-specific background concentration is used as the screening level in accordance with the CCR methodology for development of groundwater protection standards (USEPA, 2020). Background was not used as a screening level in the evaluation.

Table 1 presents the maximum detected concentration of each SSL-related constituent, which was used to represent potential off-site groundwater quality for comparison to the selected screening levels for hypothetical off-site residential receptors. The maximum detected concentration of selenium of 0.33 mg/L exceeded the screening level of 0.10 mg/L. Selenium was thereby identified as a COPI and retained for further evaluation in the refined risk evaluation. Concentrations of beryllium were below the health-protective screening level of 0.025 mg/L, and therefore, no further evaluation of beryllium was necessary.

4 REFINED RISK EVALUATION

A refined risk evaluation was conducted for the groundwater COPI, selenium, that was detected at concentrations that exceeded the health-protective screening criterion. The refined risk evaluation identified EPCs for selenium in groundwater for the purposes of characterizing potential risk to human receptors.

4.1 Refined Groundwater Risk Evaluation

Potential risk associated with exposure to selenium by hypothetical off-site residential receptors was refined using the methodology described in HSRA and VRP and other supporting guidance (EPD, 2018; EPD, 2009; EPD, 2015) and is presented in the following section and on **Figure 7**.

For the refined risk evaluation, groundwater data from samples collected between 2016 and February 2022 from the on-site wells that were identified to have SSL-related constituents and downgradient monitoring wells/piezometers that represent groundwater flow in the same hydrologically downgradient direction were used to evaluate hypothetical off-site residential exposure.

The downgradient groundwater monitoring wells and piezometers included in the refined risk evaluation are depicted with yellow well labels on **Figure 2**. The following list of wells used to assess hypothetical off-site residential exposure includes those wells with SSL-related constituents along with the wells and piezometers downgradient of the wells exhibiting SSLs:

YGWC-22S	YGWC-38 (SSL)	YAMW-1
YGWC-23S	PZ-37 (SSL)	YAMW-5
YGWC-32I	PZ-37D	PZ-52D
YGWC-32S	PZ-35	YGWC-26I (AP-2)
YGWC-34I	YGWC-36	YGWC-26S (AP-2)
	YGWC-36A	

Groundwater data used in the risk screening level evaluation were collected from the uppermost aquifer and are considered to be representative of groundwater conditions at the site. The groundwater dataset used in the refined risk evaluation is presented in **Appendix B.**

4.1.1 Groundwater Exposure Point Calculation

The refined risk evaluation for selenium includes the development of EPCs. The EPC is a conservative estimate of potential exposure to a receptor. The EPC is based on the 95 percent upper confidence limit of the arithmetic mean (UCL) and accounts for uncertainty and variability in the dataset (USEPA, 2002). Consistent with USEPA guidance for developing groundwater EPCs (USEPA, 2014), UCLs were calculated using USEPA ProUCL 5.1 software (ProUCL) (USEPA, 2016) and user's guide (USEPA, 2015a). For the refined risk evaluation, the UCLs for the COPI in groundwater were calculated for the following specific datasets:

- UCLs for the individual well(s) with SSL-related constituents;
- UCLs based on combined data from the well(s) with SSL-related constituents and other well(s)/piezometer(s) in the general vicinity to include additional downgradient monitoring well(s)/piezometer(s) that represent groundwater flow in the same hydrologically downgradient direction; and
- UCLs based on the combined data from the farthest downgradient well(s)/piezometer(s) that are hydrologically downgradient of the well(s) with an SSL-related constituent.

Other assumptions made in the calculations of the UCLs include:

- Primary samples (no duplicates) were used to calculate EPCs as duplicate samples were analyzed for quality assurance purposes.
- If the calculated UCL exceeded the maximum detected concentration, then the maximum detected concentration was used as the EPC.

ProUCL software calculates multiple UCLs and provides a recommended UCL that was selected as the EPC. If there were multiple UCLs recommended by ProUCL, the maximum UCL value was selected as a conservative measure. **Appendix D-1** provides a detailed summary of the UCLs calculated using the methods described above, and **Appendix D-2** presents figures showing the wells used in the calculation of the EPCs for selenium. **Appendix D-3** provides the input and output files associated with the ProUCL software.

Table 2 summarizes the groundwater EPC selected for selenium. This table shows the number of samples, the maximum detected concentration, the UCL recommended by ProUCL software, and the selected EPC.

4.1.2 COPI Concentration Trend Analysis

Concentration trends over time were evaluated as one line of evidence in the refined risk evaluation for selenium. The Mann-Kendall trend test with an alpha value equal to 0.05 and the Theil-Sen line test were conducted on the data from YGWC-38 and PZ-37 for selenium to evaluate the trends in concentrations over time. The tests were conducted using the USEPA ProUCL 5.1 software (USEPA, 2016).

The Mann-Kendall and Theil-Sen test results are presented on time series graphs in **Appendix D-4** and indicated statistically significant decreasing trends in selenium concentrations over time at YGWC-38 and insufficient evidence of a statistical trend at PZ-37. Appendix F of the *Remedy Selection Report* presented a groundwater trending evaluation using only the data collected following closure of R6, which indicated statistically significant decreasing trends in P-37 and YGWC-38.

4.1.3 Refined Groundwater Risk Evaluation Results

In the refined risk evaluation, comparison of the calculated EPC to the screening level was used to identify constituents of interest (COIs) that may pose a potential risk to hypothetical off-site residential receptors exposed through the use of groundwater as potable water. If the EPC from the farthest downgradient well(s) is greater than the respective screening level, then the constituent is identified as having the potential for risk that warrants additional evaluation (e.g., performing a surface water evaluation).

Selenium was detected in 24 out of 30 groundwater samples in wells YGWC-38 and PZ-37 at concentrations that exceeded the groundwater screening level for residential receptors. For the refined risk evaluation, the following EPCs were calculated for selenium using the monitoring wells/piezometers shown in **Appendices D-1** and **D-2**:

- Data from YGWC-38 and PZ-37 were combined to determine if the UCL was less than the screening level (EPC Step 1 in **Appendix D-1**).
- Data from YGWC-38 and PZ-37 and the downgradient wells/piezometers YAMW-1, YAMW-5, PZ-37D, YGWC-23S, YGWC-22S, YGWC-34I, YGWC-32I, YGWC-32S, PZ-35, YGWC-36, YGWC-36A, PZ-52D, YGWC-26S (AP-2), and YGWC-26I (AP-2) were combined to represent groundwater exposure in the same hydraulically downgradient direction (EPC Step 2 in **Appendix D-1**).
- Data from YGWC-26S (AP-2) and YGWC-26I (AP-2) were combined to represent groundwater exposure using the wells that are the farthest hydraulically downgradient of R6-AMA wells YGWC-38 and PZ-37 (EPC Step 3 in **Appendix D-1**).

Although EPC Step 1 exceeded the applicable screening level, both EPC Steps 2 and 3, which included the farthest downgradient wells, were below the applicable screening level for selenium. Selenium concentrations in on-site groundwater monitoring wells were delineated to concentrations not exceeding the health-protective screening level on-site.

Table 3 presents the results of the refined screening comparing the farthest hydrologically downgradient EPC (EPC Step 3) to the screening level. As EPC Steps 2 and 3 were below the applicable screening level, selenium was not identified as a groundwater COI for hypothetical off-site residential receptors and is not expected to pose a risk to human health through potable water use.

4.1.4 Refined Groundwater Risk Evaluation Summary and Conclusions

Detections of selenium were reported at concentrations above the groundwater screening level. However, the results of the refined risk evaluation for groundwater indicate the following:

- Selenium is not expected to pose a risk to hypothetical off-site residential receptors.
- All of the individual data points used to calculate the selenium EPC to represent potential groundwater exposure for hypothetical off-site residential receptors based on the farthest hydrologically downgradient monitoring wells were below the health-protective screening level.
- A statistically significant decreasing trend in selenium concentrations has been observed at YGWC-38 over time.

Therefore, based on the multiple lines of evidence and various conservative assumptions, further risk evaluation for groundwater is not warranted. Compliance groundwater monitoring under the Federal and State CCR Rules will continue. Downgradient monitoring wells YGWC-26I and YGWC-26S will also continue to be monitored under the AP-2 compliance groundwater monitoring program.

5 UNCERTAINTY ASSESSMENT

USEPA guidance stresses the importance of providing an analysis of uncertainties so that risk managers are better informed when evaluating risk assessment conclusions (USEPA, 1989). The uncertainty assessment provides a better understanding of the key uncertainties that are most likely to affect the risk assessment results and conclusions.

The potential uncertainties associated with the risk evaluation are as follows:

Health-Protective Screening Criteria Uncertainties:

- In accordance with standard practice and methodologies approved by the Georgia EPD, the higher of the Type 1 or Type 2 standard was selected for screening criteria. Selection of the screening criteria per standard practice is considered appropriate for risk quantification for R6-AMA. The Hazardous Site Response Act, Rule 391-3-19.07(1) notes that "*[a]ll risk reduction standards will, when implemented, provide adequate protection of human health and the environment*". Thus, this approach is likely to overestimate risks for hypothetical off-site receptors.

- Screening criteria based on RRSs, including beryllium and selenium, represent the reasonable maximum exposure (RME). The RME is defined as "the highest exposure that is reasonably expected to occur at a site but that is still within the range of possible exposures" (USEPA, 1989). USEPA (1989) states that the "intent of the RME is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures". Potential receptors will likely have lower exposures than those presented in this risk evaluation (i.e., a majority of the site concentrations will be less than the UCL), and therefore, potential exposures are likely overestimated.

Exposure Uncertainties:

- The maximum detected concentrations of SSL-related constituents were compared to conservative screening criteria to identify the COPIs. Use of the maximum detected concentration is generally consistent with standard risk assessment practice; however, use of the maximum detected concentration for exposure likely overestimates potential risk.

- The constituents included in the risk evaluation occur naturally in the site geologic setting. Although background concentrations were evaluated and used in the screening process, contributions to exposure and risk were assumed to be entirely CCR-related and natural background sources were not quantified. Thus, SSL-related exposures were likely overestimated.

- Hypothetical off-site residential exposure was evaluated using on-site groundwater data from wells downgradient of R6-AMA, including data from two AP-2 wells. This comparison makes the conservative assumption that on-site groundwater may potentially migrate to off-site drinking water wells through advective transport in groundwater, but without any attenuation within the aquifer media through factors such as dilution, dispersion, or adsorption. This assumption may overestimate exposure and risk hypothetical off-site receptors.

- EPCs for metals in groundwater were assumed to be 100 percent bioavailable by ingestion and dermal contact. This assumption may tend to overestimate risk.

- An off-site well survey of potential groundwater wells within a three-mile radius of Plant Yates was conducted by NewFields in 2020 and consisted of reviewing publicly available federal, state, and county records as well as a windshield survey of the area (**Appendix A**). Wood relied on the data collected by Newfields. In addition, three wells found west of the Chattahoochee River that were identified in the *2021 Annual Groundwater Monitoring and Corrective Action Report* (Arcadis, 2022) were also included on **Figure 5**.

  Although off-site potable wells identified in the well survey were not included in the risk evaluation, the presence of these wells do not appear to change the conclusions of the risk evaluation because concentrations of selenium were either below the health-protective screening criteria or delineated to concentrations below health-protective screening criteria on-site (i.e., either within R6-AMA or the downgradient AP-2 groundwater monitoring networks).

Toxicity Uncertainties:

- Toxicity factors used to calculate health-protective criteria are established at conservative levels to account for uncertainties and often result in criteria that are many times lower than the levels observed to cause effects in human or animal studies. Therefore, a screening level exceedance does not necessarily equate to an adverse effect.

6 CONCLUSIONS

This human health risk and ecological evaluation for SSL-related constituents in groundwater at the site was conducted using methods generally consistent with Georgia EPD and USEPA guidance and included multiple conservative assumptions. Based on this evaluation, beryllium and selenium are not expected to pose a risk to human health or the environment.

Accordingly, no further risk evaluation of groundwater is recommended. Compliance groundwater monitoring for R6-AMA under the Federal and State CCR Rules will continue. Georgia Power will proactively evaluate the data and update this evaluation, if necessary.

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TABLES

Table 1
SSL-Related Constituent Groundwater Screening
Yates R6-AMA Risk Evaluation Report
Plant Yates, Newnan, Coweta County, GA

CCR Rule Designation	Constituent	CAS No.	Detection Frequency[1]	Exceedance Frequency[2]	Maximum Concentration (mg/L)	Screening Level (mg/L)	Source	Site-Specific Background (mg/L)	COPI? (Y/N)	Rationale[3]
Appendix IV	Beryllium	7440-41-7	17 / 17	0 / 17	0.0059	0.025	Type 2 RRS[4]	0.0005	N	BSL
	Selenium	7782-49-2	30 / 30	24 / 30	0.330	0.10	Type 2 RRS[4]	0.005	Y	ASL

Notes:
[1] Evaluation includes 2017 through February 2022 groundwater analytical data from wells YGWC-38 for beryllium and YGWC-38 and PZ-37 for selenium.
[2] Exceedance frequency is for the specific constituent that exceeds the first screening value in the hierarchy of screening values.
[3] Rationale for classification of constituent as a COPI or exclusion as a COPI:
ASL = Above respective screening level
BSL = Equal to or below respective screening level

[4] The Type 2 RRSs are calculated by the EPA RSL calculator using residential exposure factor inputs from HSRA Appendix III, Table 3.

Definitions:
CAS = Chemical Abstract Service
CCR = Coal Combustion Residuals
COPI = Constituent of Potential Interest
RRS = Risk Reduction Standard
mg/L = milligrams per Liter

Prepared by/Date: JHG 04/29/22
Checked by/Date: IMR 04/29/22

Table 2
Groundwater Exposure Point Concentration Summary
Yates R6-AMA Risk Evaluation Report
Plant Yates, Newnan, Coweta County, GA

Exposure Unit	CCR Rule Designation	Constituent	CAS No.	Detection Frequency	Maximum Concentration (mg/L)	95% UCL (mg/L)	Recommended UCL Method	Selected EPC[1] (mg/L)
R6-AMA	Appendix IV	Selenium[2]	7782-49-2	21 / 38	0.0042	0.0024	95% KM (t) UCL	0.0024

Notes:
[1] EPCs calculated in accordance with USEPA, 2014. Memorandum for Determining Groundwater Exposure Point Concentrations, Supplemental Guidance. OSWER Directive 9283.1-42, February 2014. Located at https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917.

EPC used in refined screening presented in Table 3.
[2] Selenium EPC based on EPC Step 3 data from AP-2 wells YGWC-26S and YGWC-26I. For further detail on the selected EPC, refer to Appendix D.

Definitions:
CAS = Chemical Abstract Service
CCR = Coal Combustion Residuals
mg/L = milligrams per liter
95% UCL = 95 percent upper confidence limit
EPC = Exposure Point Concentration

Prepared by/Date: JHG 04/29/22
Checked by/Date: IMR 04/29/22

Table 3
Downgradient Groundwater Refined Screening
Yates R6-AMA Risk Evaluation Report
Plant Yates, Newnan, Coweta County, GA

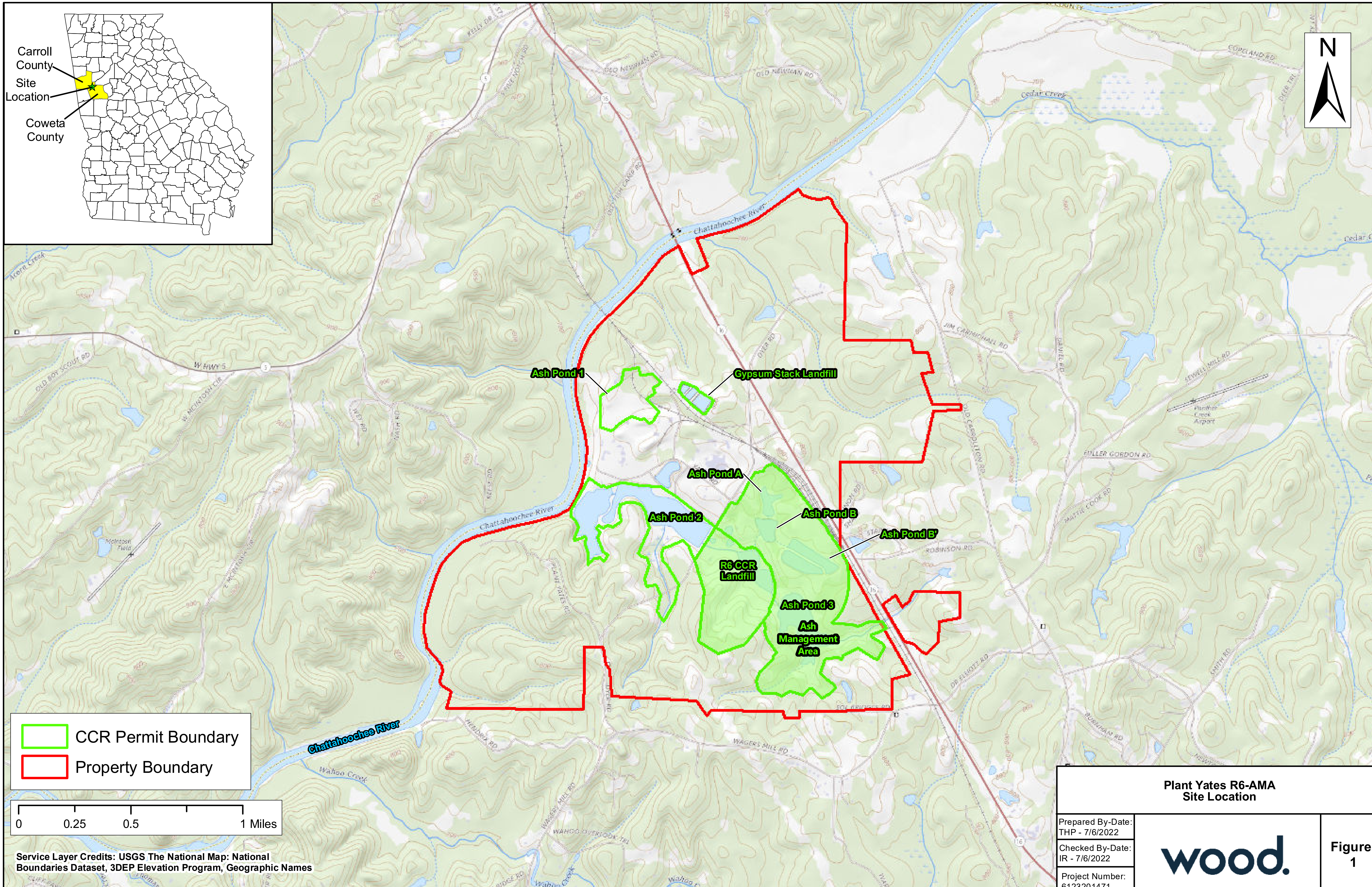
Exposure Unit	CCR Rule Designation	Constituent	CAS No.	Detection Frequency	Exceedance Frequency[1]	Selected EPC[2] (mg/L)	Screening Level (mg/L)	Source	Site-Specific Background (mg/L)	COI? (Y/N)	Rationale[3]
R6-AMA	Appendix IV	Selenium	7782-49-2	21 / 38	0 / 38	0.0024	0.10	Type 2 RRS[4]	0.005	N	BSL

Notes:
[1] The exceedance frequency is based on the number of samples with detected concentrations that exceed the identified screening level.
[2] EPCs calculated in accordance with USEPA, 2014. Memorandum for Determining Groundwater Exposure Point Concentrations, Supplemental Guidance. OSWER Directive 9283.1-42, February 2014. Located at https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917. For further detail on the selected EPC, refer to Appendix D.
[3] Rationale for classification of constituent as a COI or exclusion as a COI:
ASL = Above respective screening level
BSL = Below respective screening level
[4] The Type 2 RRSs are calculated by the EPA RSL calculator using residential exposure factor inputs from HSRA Appendix III, Table 3.

Definitions:
CAS = Chemical Abstract Service
CCR = Coal Combustion Residuals
COI = Constituent of Interest
mg/L = milligrams per liter
EPC = Exposure Point Concentration

Prepared by/Date: JHG 04/29/22
Checked by/Date: IMR 04/29/22

FIGURES

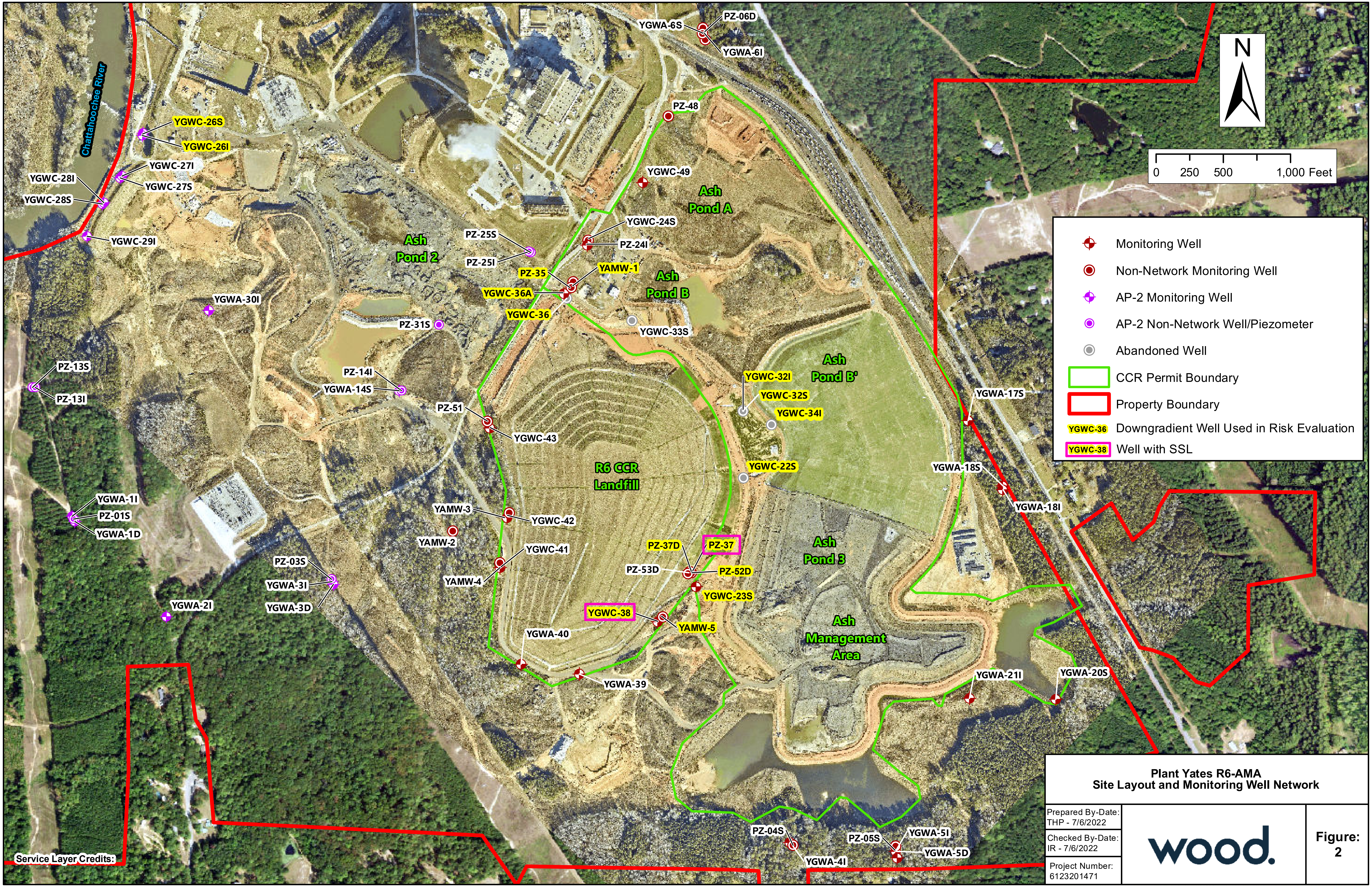


Plant Yates R6-AMA
Site Location

Prepared By-Date: THP - 7/6/2022
Checked By-Date: IR - 7/6/2022
Project Number: 6123201471

wood.

Figure: 1



Chattahoochee River
YGWA-6S
PZ-06D
YGWA-6I
PZ-48
YGWC-49
Ash Pond A
YGWC-26S
YGWC-26I
YGWC-27I
YGWC-27S
YGWC-28I
YGWC-28S
YGWC-29I
Ash Pond 2
PZ-25S
PZ-25I
YGWC-24S
PZ-24I
PZ-35
YAMW-1
Ash Pond B
YGWC-36A
YGWC-36
YGWA-30I
PZ-31S
YGWC-33S
Ash Pond B'
PZ-13S
PZ-13I
PZ-14I
YGWA-14S
YGWC-32I
YGWC-32S
YGWC-34I
PZ-51
YGWC-43
R6 CCR Landfill
YGWC-22S
YGWA-17S
YGWA-18S
YGWA-18I
YGWA-1I
PZ-01S
YGWA-1D
YAMW-3
YGWC-42
YAMW-2
YGWC-41
YAMW-4
Ash Pond 3
PZ-37D
PZ-37
PZ-53D
PZ-52D
YGWC-23S
PZ-03S
YGWA-3I
YGWA-3D
YGWA-2I
YGWC-38
YAMW-5
Ash Management Area
YGWA-40
YGWA-39
YGWA-21I
YGWA-20S
PZ-04S
YGWA-4I
PZ-05S
YGWA-5I
YGWA-5D
Service Layer Credits:
N
0 250 500 1,000 Feet
Monitoring Well
Non-Network Monitoring Well
AP-2 Monitoring Well
AP-2 Non-Network Well/Piezometer
Abandoned Well
CCR Permit Boundary
Property Boundary
YGWC-36 Downgradient Well Used in Risk Evaluation
YGWC-38 Well with SSL
Plant Yates R6-AMA
Site Layout and Monitoring Well Network
Prepared By-Date:
THP - 7/6/2022
Checked By-Date:
IR - 7/6/2022
Project Number:
6123201471
wood.
Figure:
2

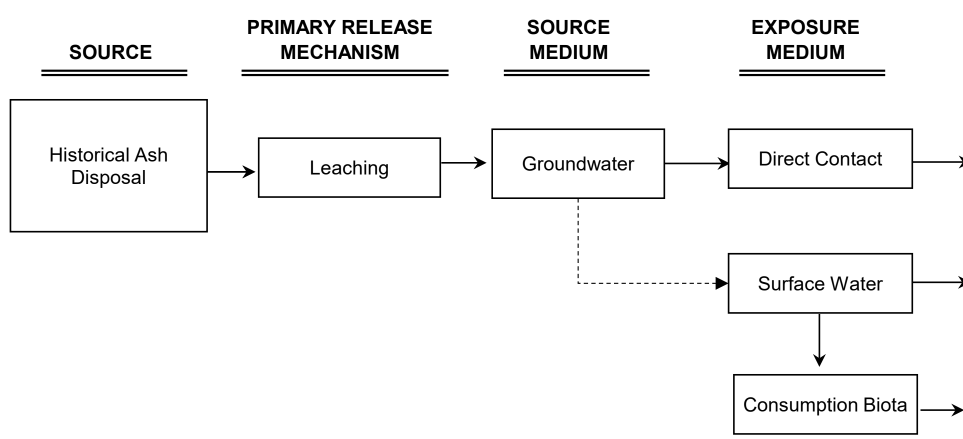
Saprolite Network Monitoring Well Location
Transition Network Monitoring Well Location
Bedrock Network Monitoring Well Location
Saprolite Non-Network Well/Piezometer
Transition Non-Network Well/Piezometer
Bedrock Non-Network Well/Piezometer
Abandoned Well
CCR Permit Boundary
Groundwater Contours (Feet) Dashed Where Inferred
Approximate Groundwater Flow Direction Dashed Where Interpreted
771.31 Groundwater Elevation (Feet)
Property Boundary

Notes:
1. SHALLOW GROUNDWATER ELEVATION ARE DERIVED FROM SOIL COMPRISED OF SAPROLITE, RANGING FROM 15 - 60 FEET BELOW GROUND SURFACE
2. BEDROCK WELLS YGWA-40, YGWA-39, YGWC-38, YGWC-41, YGWC-42 USED FOR CONTOURING. ALL OTHER BEDROCK WELLS NOT USED TO CREATE CONTOURS.
3. SAPROLITE WELL GROUNDWATER ELEVATIONS WERE USED FOR CONTOURING FOR SAPROLITE/TRANSITION ZONE/BEDROCK WELL CLUSTER LOCATIONS.
4. ELEVATION IS PRESENTED IN U.S. SURVEY FEET (NAVD 1988)
5. GROUNDWATER ELEVATIONS COLLECTED ON FEBRUARY 7, 2022.

Service Layer Credits:

Plant Yates R6-AMA
Potentiometric Surface Elevation Contours (February 2022)

Prepared By-Date: THP - 7/6/2022	wood.	Figure: 3
Checked By-Date: IR - 7/6/2022		
Project Number: 6123201471		



		HUMAN HEALTH AND ECOLOGICAL RISK EVALUATION RECEPTORS									
		HUMAN									ECOLOGICAL
		Current				Future					Current / Future
		On-Site	Off-Site			On-Site		Off-Site			Off-Site
EXPOSURE MEDIUM	EXPOSURE ROUTE	Worker [1]	Worker [2]	Child and Adult Resident	Child and Adult Recreational	Worker [1]	Child and Adult Resident	Worker [2]	Child and Adult Resident	Child and Adult Recreational	Aquatic Receptors [3]
Direct Contact	Ingestion		○	●				○	●		
	Dermal Contact		○	●				○	●		
Surface Water	Ingestion				○					○	○
	Dermal Contact				○					○	○
Consumption Biota	Ingestion				○					○	

Legend

- - - → A conservative assumption for this assessment was made that groundwater from the site flows to the downgradient surface water.

● Indicates potentially complete pathway, which is evaluated quantitatively.

○ Indicates potentially complete pathway, which is evaluated qualitatively.

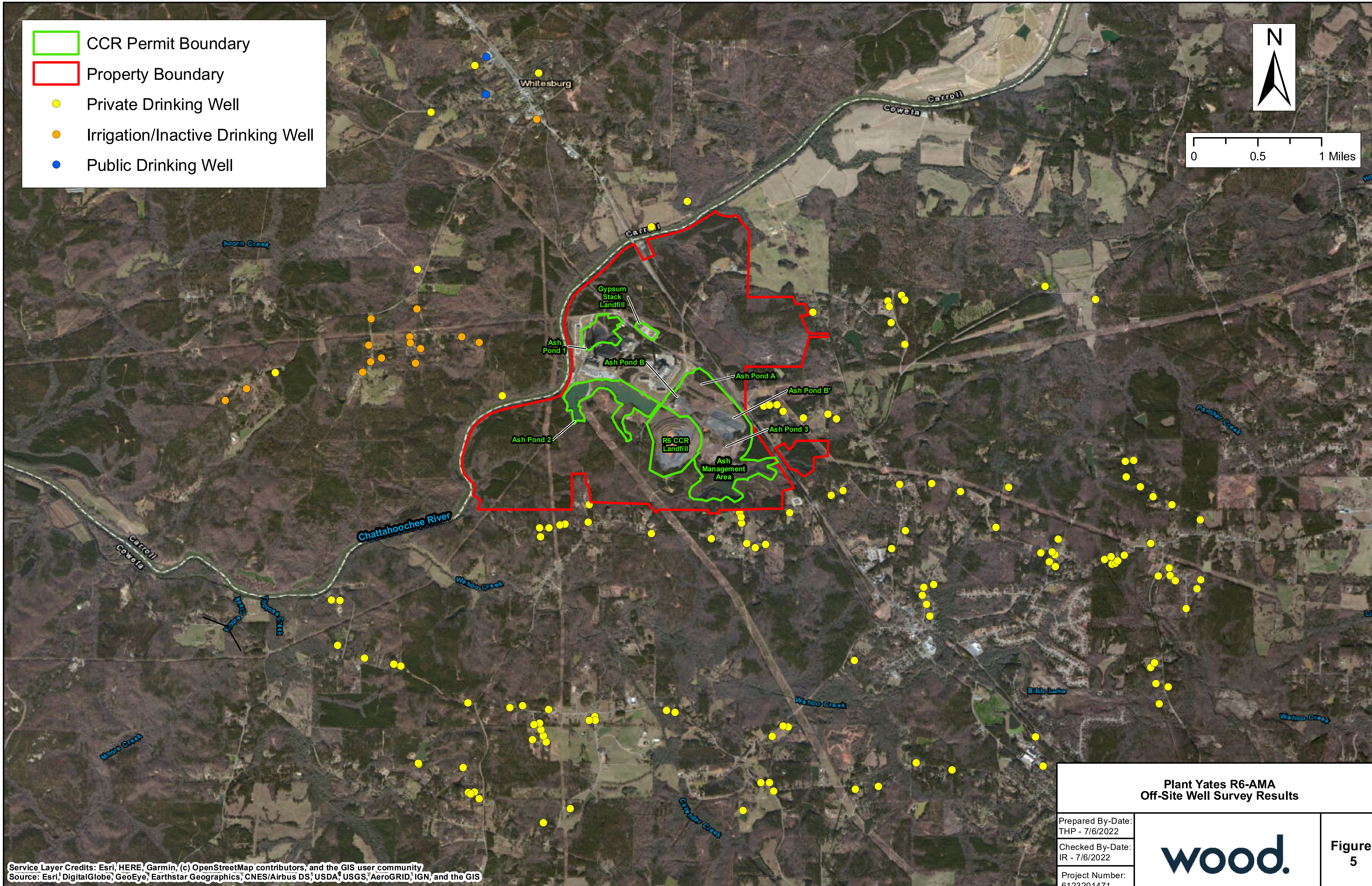
Footnotes

1. The industrial worker was considered to have no complete pathways because there are no wells on-site that are classified for use as potable wells. On-site construction workers would be expected to have little to no direct contact with on-site groundwater due to safety procedures outlined in their site-specific health and safety plans.
2. Off-site industrial/construction worker addressed through the evaluation of hypothetical off-site residential receptors as health-protective screening levels for residential receptors would be more conservative than industrial and construction worker screening levels.
3. Generalized receptor for ecological health risk evaluation.

Plant Yates R6-AMA
Conceptual Exposure Model

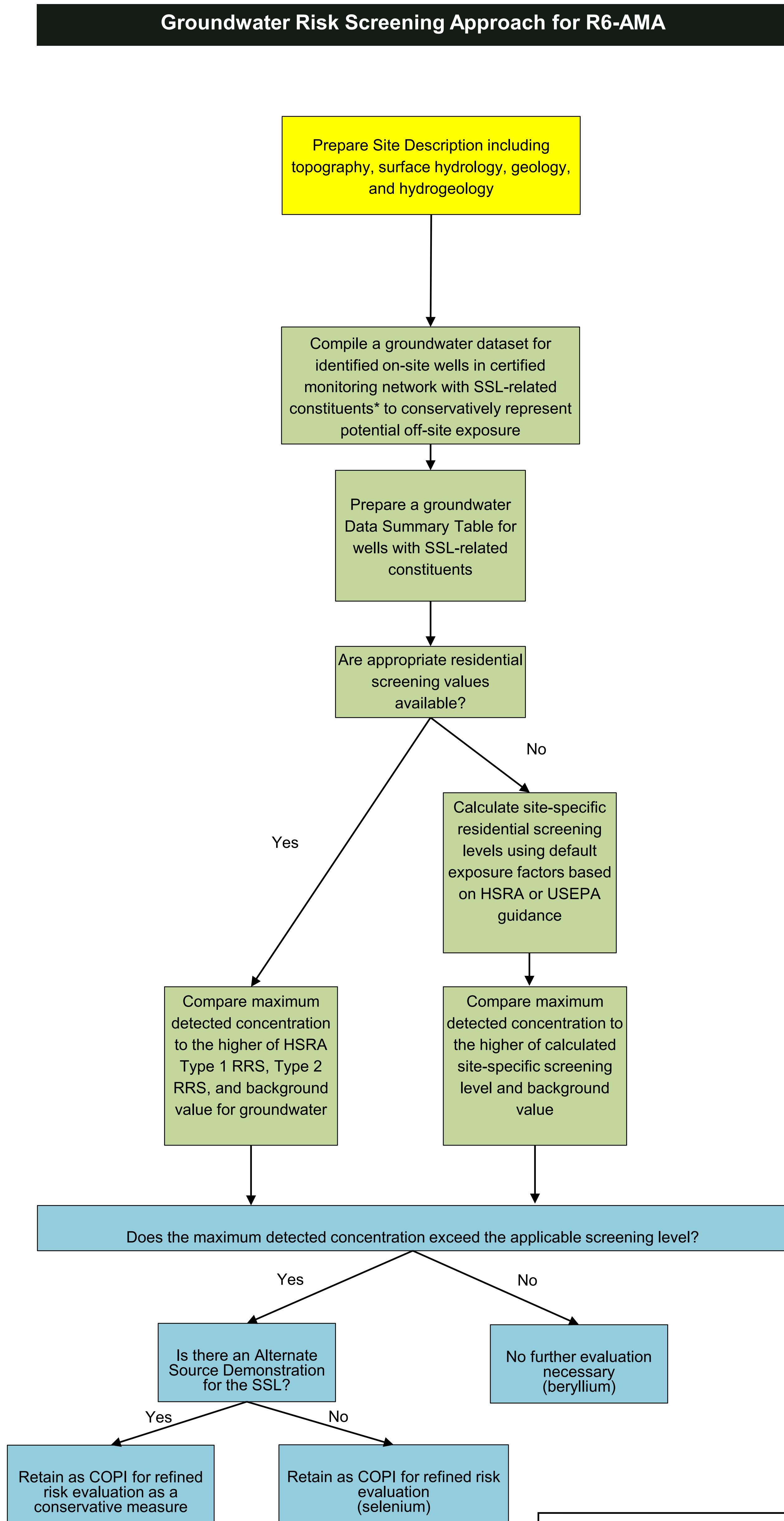
Figure 4

Project Number 6123201471	Prepared by/Date: IMR 04//28/22 Checked by/Date: NSR 04/28/22



Plant Yates R6-AMA
Off-Site Well Survey Results

Prepared By-Date: THP - 7/6/2022	wood.	Figure: 5
Checked By-Date: IR - 7/6/2022		
Project Number: 6123201471		



Notes:
Initial screen evaluates wells at R6-AMA with SSLs: beryllium (YGWC-38) and selenium (YGWC-38 and PZ-37).
SSL = Statistically Significant Level
COPI = Constituent of Potential Interest
HSRA = Hazardous Site Response Act
RRS = Risk Reduction Standard
USEPA = United States Environmental Protection Agency

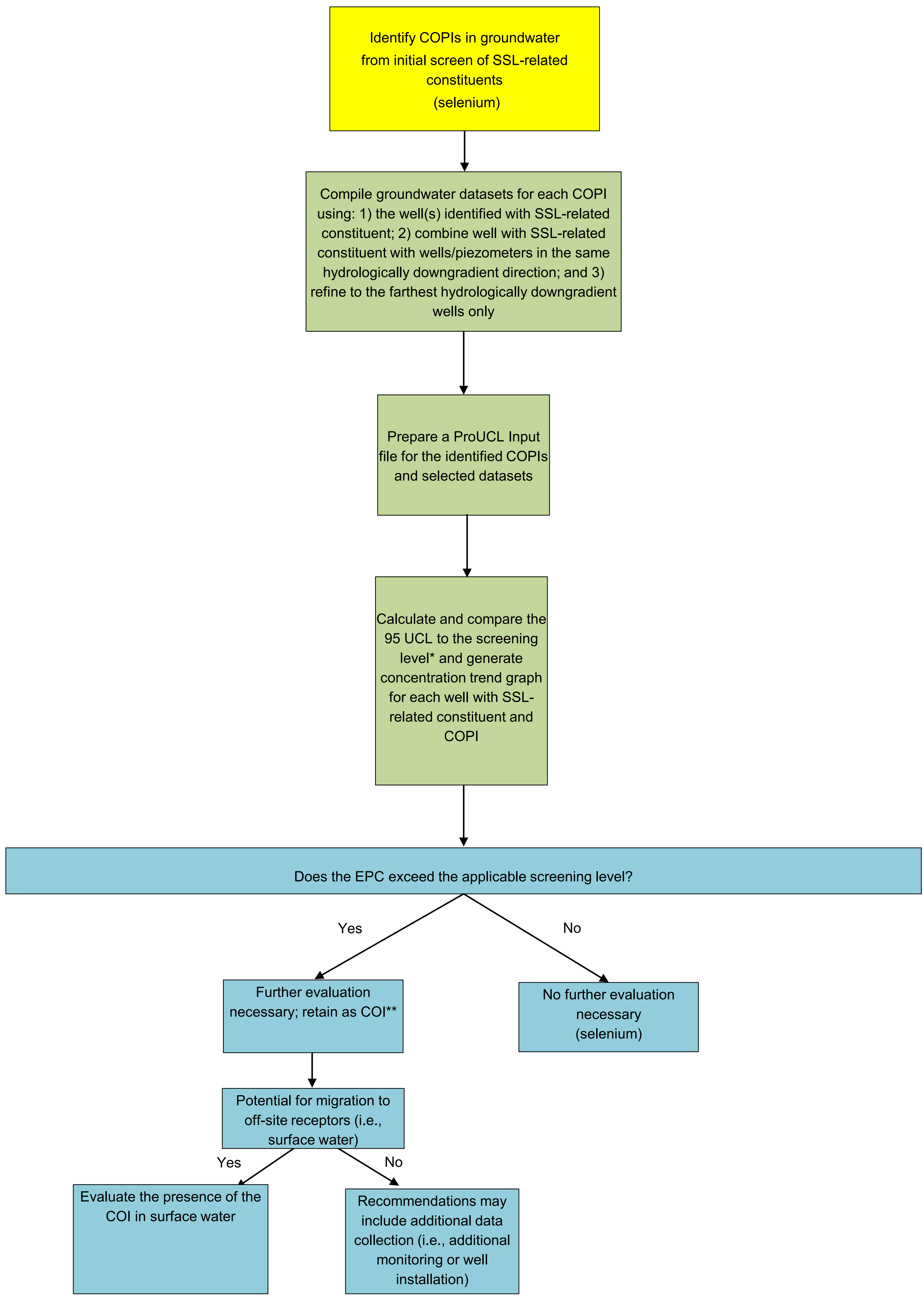
Plant Yates R6-AMA
Groundwater Risk Screening Approach

Figure 6

Project Number
6123201471

Prepared by/Date: IMR 04/27/22
Checked by/Date: NSR 05/02/22

Refined Groundwater Risk Screening Approach for R6-AMA



Notes:
*If the 95 UCL exceeds the maximum concentration, use the maximum as the EPC.
**This step is not necessary for Yates R6-AMA.
SSL = Statistically Significant Level
COPI = Constituent of Potential Interest
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit
COI = Constituent of Interest

Plant Yates R6-AMA
Approach for Refined Groundwater Risk Evaluation

Figure 7

Project Number
6123201471

Prepared by/Date: IMR 04/27/22
Checked by/Date: NSR 05/02/22

APPENDIX A

Plant Yates Well Survey (Off-Site)

NewFields

Well Survey

Plant Yates

Ash Pond 3, Ash Pond A, Ash Pond B, Ash Pond B’

Coweta County, GA

Prepared for

Georgia Power Company

241 Ralph McGill Blvd., Atlanta, GA 30308

Prepared by

NewFields

1349 W. Peachtree Street, Suite 2000

Atlanta, GA 30309

March 5, 2020

Introduction

Plant Yates is located at 708 Dyer Road in Coweta County.

Newfields conducted a well survey within a three-mile radius of the Coal Combustion Residual (CCR) facilities at Yates: Ash Pond 3 (AP-3), Ash Pond A (AP-A), Ash Pond B (AP-B), and Ash Pond B' (AP-B'). This area is referred to in this report as the Investigated Area, and is shown on Figure 1.

As part of this survey, NewFields accessed and reviewed information from a number of Federal, State, and County records and online sources, as well as a windshield surveys of the Investigated Area. Information from each identified well was then compiled into a geographic information system (GIS) database.

Information Collection

This section summarizes the sources utilized for identifying potential drinking water wells within the Investigated Area.

1. Federal Sources
    a. **United States Geological Survey (USGS).** USGS maintains an inventory database of any well sampled by a USGS-affiliated program for ground-water levels or water quality parameters at any time in the past.[1] Well information and coordinates were downloaded for the state of Georgia and compiled into the GIS database. Wells in this database are labelled 'human drinking water wells' or 'monitoring wells'; however, many of these appear to be co-located with drinking water wells. Some of these USGS monitoring wells may in fact be private drinking water wells utilized for monitoring purposes by USGS. Some listings in this database are over 50 years old and may be inactive.

    b. **Safe Drinking Water Information System (SDWIS).** This EPA database has listings of public water systems but does not have well location information. SDWIS information was used to help identify the suppliers of public water in the vicinity of the facility. Public water is available throughout the entire Investigated Area, supplied by the Carroll County Water Authority, Coweta County Water Authority, and the City of Whitesburg.

2. State Sources
    a. **Georgia Environmental Protection Division**
        i. **Drinking Water Branch.** EPD maintains records about municipal and industrial wells, whose presence or absence within a radius of a site can be ascertained by contacting the agency. An email was sent to Michael Gillis of EPD on October 23rd, 2019 requesting information about wells in the investigated area. Mr. Gillis responded stating that two wells for the City of Whitesburg are located within the Investigated Area. The City of Whitesburg system serves 931 people. NewFields

[1] http://waterdata.usgs.gov/ga/nwis/inventory?introduction

identified the location of the wells using a combination of aerial photography, parcel data indicating which parcels are owned by the city, and well information from the EPD's Drinking Water Branch online database. These two drinking water wells are located approximately 2.7 and just under 3 miles to the northwest of the Plant Yates Ash Ponds.

ii. **EPD Pesticide Project.** From 2000 to 2004, EPD undertook a project to sample private drinking water wells for pesticides. EPD solicited volunteers state-wide to participate in the well sampling program. The final report includes the list of private water wells sampled, their coordinates, and depths when available.[2] Information about wells within the Investigated Area were compiled into the GIS database.

iii. **Hazardous Site Inventory (HSI) files.** EPD maintains files for HSI files for site which are undergoing state-led corrective action. These files usually contain groundwater data and well surveys. There are no HSI sites within the Investigated Area.

iv. **Hazardous Site Response Act (HSRA) notifications.** EPD maintains non-HSI HSRA notification reports (i.e., notifications submitted after releases of reportable substances). NewFields reviewed reports associated with sites in Carroll and Coweta County. No wells were identified within the Investigated Area.

b. **Agricultural and Environmental Services Laboratory (AESL) records.** The University of Georgia's AESL Laboratory tests drinking water samples submitted by private individuals to their local county extension service. Maps of these sampling results can viewed online.[3] Precise coordinates of sampling locations are not available, but NewFields was able to use online images to find approximate locations.

3. County Sources
   a. **County Health Departments.** County health departments (DOH) maintain records of the permits for "on-site sewage management systems" (septic tanks). These permits indicate whether the permittee has private or public water supply, and often identify the exact location of the well on a map. Coweta County does not maintain these records in a manner where they are easily searchable using geographic criteria. However, Carroll County Health Department conducted a search for permits along the major roads within Investigated Areas and provided copies of nearly three dozen permits from this area. These wells were geolocated based on address.
   b. **Coweta County Water and Sewerage Authority.** The Authority provided a shapefile showing the waterlines in Coweta County, including the dates of construction. Public water is

[2] https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/PR-55.pdf
[3] http://aesl.ces.uga.edu/water/map/

available throughout the area. Earliest lines in the area were built in the mid-1980s; water mains closest to the plant were not built until the mid-1990s.

c. **Tax Assessor Records.** Tax parcel shapefiles were acquired from the Coweta County GIS Department on October 2, 2019. Additional tax parcel data, including information about the age of structures on the property, was obtained on October 14, 2019 from the County Tax Assessor's Office. Carroll County Tax Assessor's office provided tax parcel shape and improvement data on October 23, 2019.

d. **Tax Assessor Web site.** The Carrol County Tax Assessor's Web site[4] lists information about the water source for each parcel. However, this data cannot be downloaded, but must be searched for parcels one at a time. NewFields used the Web site to check the water source for wells identified using all other sources. NewFields determined that public water use is widespread regardless of the age of homes.

4. Windshield Surveys
   a. A windshield survey of the Investigated Area was conducted on October 15th, 2019. During the survey a number of wells were visually identified, which were subsequently compiled into the GIS database. A windshield survey update was conducted on October 15th, 2019. The majority of wells identified during the survey were near residences.

Summary

In addition to identifying specific wells from the above listed sources, NewFields used a combination of parcel data and information about the presence and age of public water infrastructure in Coweta County to identify parcels that may be using well water as their drinking water source or had drinking water wells at some time. Many of these parcels may be (or have been) sharing wells, so a well might not exist for each identified parcel. A large number of structures in Coweta County significantly predate the nearest waterlines. While these wells are labelled 'drinking water wells', many of those may be inactive. Some parcels may not each have their own well, but may have shared wells.

In the Carroll County portion of the Investigated Area, NewFields did not use parcel data to identify potential wells. The search of the Tax Assessor's Web site showed that public water use is widespread in this area, even in older homes and homes with visible windshield survey wells. Most wells seen in Carroll County were therefore assumed to be irrigation wells or inactive drinking water wells, with exception of a small number of apparently active drinking water wells confirmed with Tax Assessor data.

Dense parcels in Arnco and Sargent, between 2 and 3 miles southeast of Plant Yates and within the Investigated Area, were assumed to be connected to public water. These small communities appear to have had their own water supply in the past and later switched to Coweta County.

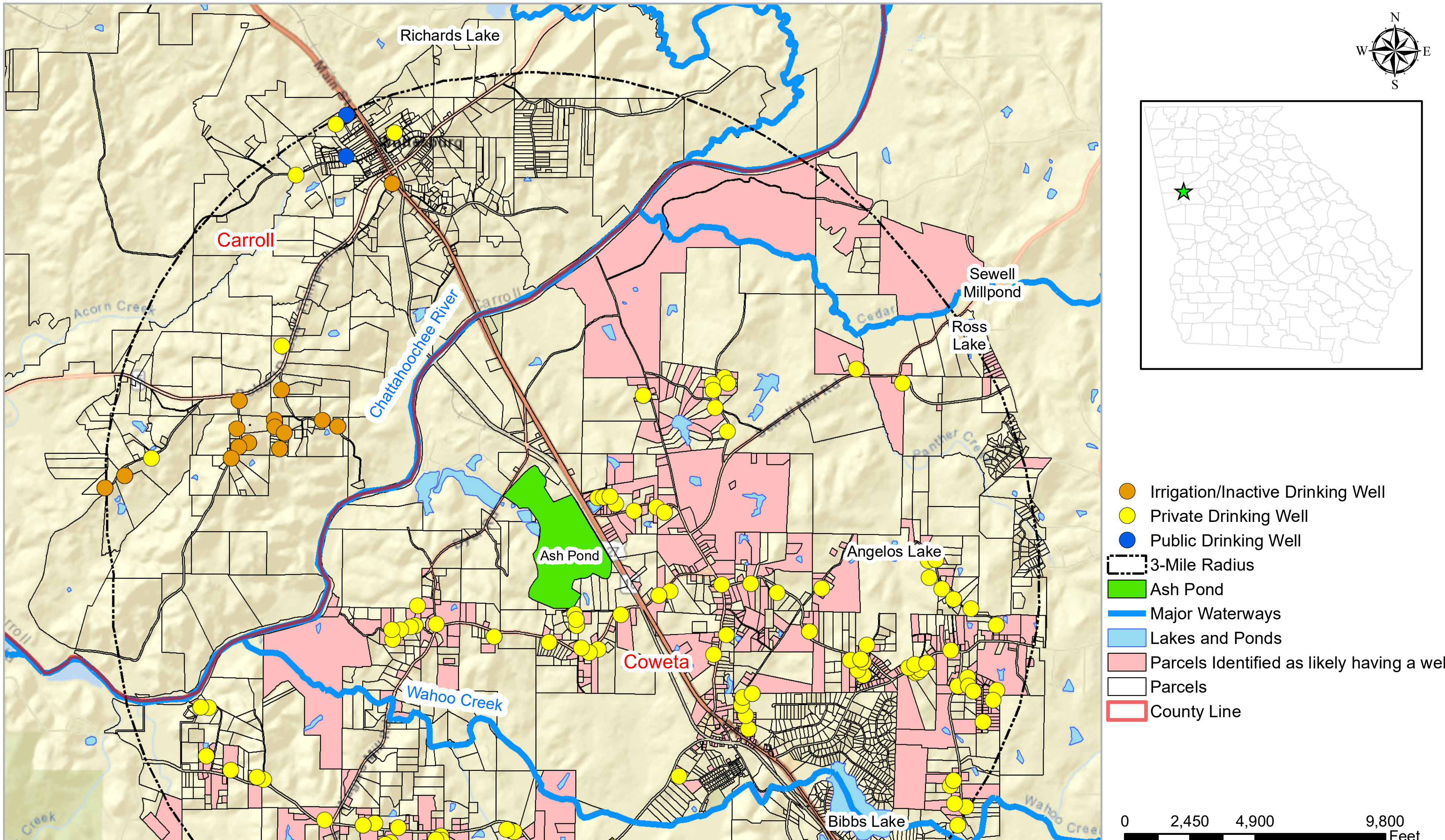
Public water is available throughout the entire surveyed area, supplied by the Carroll County Water Authority, Coweta County Water Authority, and the City of Whitesburg. Two public wells are located

[4] https://qpublic.schneidercorp.com/Application.aspx?App=CarrollCountyGA&Layer=Parcels&PageType=Search

within the Investigated Area, northeast of the Ash Ponds. These wells belong to the City of Whitesburg, a system that serves 931 people via 358 connections. The approximate locations of these wells are shown on Figure 1, which shows points for all identified wells, and shades parcels that were identified from parcel data as likely to are likely to contain wells. When viewed as a PDF file, the figure is interactive, and wells identified using different sources can be turned on and off.

Combining well data from all sources with parcel data, NewFields identified 728 total parcels likely to be associated with an active or inactive private well within the Investigated Area. Of these, 665 parcels were identified using parcel data. One hundred and twenty-five (125) wells were identified during the windshield survey. Twelve (12) of the wells seen during the windshield survey in Carroll County were assumed to be inactive or irrigation wells, since the tax assessor's Web site stated these properties were on public water. Eighteen (18) wells were identified using USGS sources, and one (1) from the EPD's Pesticide Sampling Project. Many wells were identified by multiple sources.[5]

[5] USGS monitoring wells located on Georgia Power property were also considered not to be drinking water wells and omitted.



Title	**Plant Yates – AP-A, AP-3, AP-B, and AP-B'**		
Project	**GPC Plants Georgia**		
NewFields	Two Midtown Plaza 1349 W. Peachtree St, #2000 Atlanta, Georgia 30309 Tel: 404-347-9050		
Date	10/28/2019	Rev. No.	0
MXD	gpc_ccr_2019/agis	Figure No.	1

APPENDIX B
Data Used in Risk Evaluation

Appendix B
Site Groundwater Data (2016-2022) for Evaluation of SSLs
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Well	Date	CAS	Constituent	Units	Obs	Flags	MDL	PQL
YGWC-38	2/10/2022	7440-41-21	Beryllium	mg/l	0.0027		0.000054	0.0005
YGWC-38	8/26/2021	7440-41-20	Beryllium	mg/l	0.0028		0.000054	0.0005
YGWC-38	3/4/2021	7440-41-20	Beryllium	mg/l	0.0029		0.000046	0.0005
YGWC-38	2/9/2021	7440-41-19	Beryllium	mg/l	0.0029	J	0.000046	0.003
YGWC-38	9/25/2020	7440-41-19	Beryllium	mg/l	0.0033		0.000046	0.003
YGWC-38	3/25/2020	7440-41-18	Beryllium	mg/l	0.0038		0.000074	0.003
YGWC-38	2/14/2020	7440-41-17	Beryllium	mg/l	0.0042		0.000074	0.003
YGWC-38	10/9/2019	7440-41-16	Beryllium	mg/l	0.0046		0.000074	0.003
YGWC-38	8/22/2019	7440-41-15	Beryllium	mg/l	0.0049		0.000074	0.003
YGWC-38	9/24/2018	7440-41-14	Beryllium	mg/l	0.0051		0.00005	0.003
YGWC-38	8/7/2018	7440-41-13	Beryllium	mg/l	0.0058		0.00005	0.003
YGWC-38	6/28/2018	7440-41-12	Beryllium	mg/l	0.0059		0.00005	0.003
YGWC-38	4/3/2018	7440-41-11	Beryllium	mg/l	0.0056		0.00005	0.003
YGWC-38	2/20/2018	7440-41-10	Beryllium	mg/l	0.0053		0.00005	0.003
YGWC-38	1/12/2018	7440-41-9	Beryllium	mg/l	0.0053		0.00009	0.003
YGWC-38	11/20/2017	7440-41-8	Beryllium	mg/l	0.0053		0.00009	0.003
YGWC-38	10/12/2017	7440-41-7	Beryllium	mg/l	0.0057		0.00009	0.003
YGWC-38	2/10/2022	7782-49-2	Selenium	mg/l	0.064		0.0014	0.005
YGWC-38	8/26/2021	7782-49-2	Selenium	mg/l	0.06		0.0014	0.005
YGWC-38	3/4/2021	7440-41-9	Selenium	mg/l	0.076		0.0016	0.005
YGWC-38	2/9/2021	7440-41-8	Selenium	mg/l	0.073		0.0016	0.01
YGWC-38	9/25/2020	7782-49-2	Selenium	mg/l	0.076		0.0016	0.01
YGWC-38	3/25/2020	7782-49-2	Selenium	mg/l	0.099		0.0013	0.01
YGWC-38	2/14/2020	7782-49-2	Selenium	mg/l	0.11		0.0013	0.01
YGWC-38	10/9/2019	7782-49-2	Selenium	mg/l	0.12		0.0013	0.01
YGWC-38	8/22/2019	7782-49-2	Selenium	mg/l	0.14		0.0013	0.01
YGWC-38	9/24/2018	7782-49-2	Selenium	mg/l	0.2		0.0014	0.01
YGWC-38	8/7/2018	7782-49-2	Selenium	mg/l	0.2		0.0014	0.01
YGWC-38	6/28/2018	7782-49-2	Selenium	mg/l	0.23		0.0014	0.01
YGWC-38	4/3/2018	7782-49-2	Selenium	mg/l	0.23		0.0014	0.01
YGWC-38	2/20/2018	7782-49-2	Selenium	mg/l	0.253		0.0014	0.01
YGWC-38	1/12/2018	7782-49-2	Selenium	mg/l	0.249		0.0018	0.01
YGWC-38	11/20/2017	7782-49-2	Selenium	mg/l	0.246		0.0018	0.01
YGWC-38	10/12/2017	7782-49-2	Selenium	mg/l	0.265		0.0018	0.01
YAMW-5	2/10/2022	7782-49-2	Selenium	mg/l	0.057		0.0014	0.005
YAMW-5	8/26/2021	7782-49-2	Selenium	mg/l	0.055		0.0014	0.005
YAMW-5	3/4/2021	7782-49-2	Selenium	mg/l	0.061		0.0016	0.005
YAMW-5	2/9/2021	7782-49-2	Selenium	mg/l	0.06		0.0016	0.01
YAMW-5	9/24/2020	7782-49-2	Selenium	mg/l	0.026		0.0016	0.01
YAMW-5	1/15/2020	7782-49-2	Selenium	mg/l	0.045		0.0013	0.01
YGWC-23S	2/10/2022	7782-49-2	Selenium	mg/l	0.039		0.0014	0.005
YGWC-23S	8/25/2021	7782-49-2	Selenium	mg/l	0.032		0.0014	0.005
YGWC-23S	3/4/2021	7782-49-2	Selenium	mg/l	0.037		0.0016	0.005
YGWC-23S	2/9/2021	7782-49-2	Selenium	mg/l	0.032		0.0016	0.01
YGWC-23S	9/24/2020	7782-49-2	Selenium	mg/l	0.031		0.0016	0.01
YGWC-23S	3/26/2020	7782-49-2	Selenium	mg/l	0.024		0.0013	0.01
YGWC-23S	2/17/2020	7782-49-2	Selenium	mg/l	0.02		0.0013	0.01
YGWC-23S	9/27/2019	7782-49-2	Selenium	mg/l	0.018		0.0013	0.01
YGWC-23S	4/4/2019	7782-49-2	Selenium	mg/l	0.017		0.0014	0.01
YGWC-23S	3/6/2019	7782-49-2	Selenium	mg/l	0.019		0.0014	0.01
YGWC-23S	9/27/2018	7782-49-2	Selenium	mg/l	0.023		0.0014	0.01

Appendix B
Site Groundwater Data (2016-2022) for Evaluation of SSLs
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Well	Date	CAS	Constituent	Units	Obs	Flags	MDL	PQL
YGWC-23S	6/12/2018	7782-49-2	Selenium	mg/l	0.026		0.0014	0.01
YGWC-23S	3/30/2018	7782-49-2	Selenium	mg/l	0.028		0.0014	0.01
YGWC-23S	7/10/2017	7782-49-2	Selenium	mg/l	0.0386		0.0018	0.01
YGWC-23S	5/2/2017	7782-49-2	Selenium	mg/l	0.0395		0.0014	0.01
YGWC-23S	3/9/2017	7782-49-2	Selenium	mg/l	0.0437		0.0014	0.01
YGWC-23S	1/16/2017	7782-49-2	Selenium	mg/l	0.0469		0.001	0.01
YGWC-23S	11/8/2016	7782-49-2	Selenium	mg/l	0.0521		0.001	0.01
YGWC-23S	9/20/2016	7782-49-2	Selenium	mg/l	0.0464		0.001	0.01
YGWC-23S	7/28/2016	7782-49-2	Selenium	mg/l	0.0385		0.0009	0.01
YGWC-23S	6/7/2016	7782-49-2	Selenium	mg/l	0.037		0.00024	0.0013
PZ-37	2/10/2022	7782-49-2	Selenium	mg/l	0.2		0.0014	0.005
PZ-37	8/25/2021	7782-49-2	Selenium	mg/l	0.2		0.0014	0.005
PZ-37	3/4/2021	7782-49-2	Selenium	mg/l	0.27		0.0016	0.005
PZ-37	2/9/2021	7782-49-2	Selenium	mg/l	0.28		0.0016	0.01
PZ-37	9/25/2020	7782-49-2	Selenium	mg/l	0.32		0.0016	0.01
PZ-37	9/24/2018	7782-49-2	Selenium	mg/l	0.33		0.0014	0.01
PZ-37	8/6/2018	7782-49-2	Selenium	mg/l	0.21		0.0014	0.01
PZ-37	6/29/2018	7782-49-2	Selenium	mg/l	0.26		0.0014	0.01
PZ-37	4/3/2018	7782-49-2	Selenium	mg/l	0.28		0.0014	0.01
PZ-37	2/20/2018	7782-49-2	Selenium	mg/l	0.315		0.0014	0.01
PZ-37	1/11/2018	7782-49-2	Selenium	mg/l	0.168		0.0018	0.01
PZ-37	11/21/2017	7782-49-2	Selenium	mg/l	0.225		0.0018	0.01
PZ-37	10/12/2017	7782-49-2	Selenium	mg/l	0.234		0.0018	0.01
PZ-37D	2/11/2022	7782-49-2	Selenium	mg/l		ND	0.0014	0.005
PZ-37D	9/3/2021	7782-49-2	Selenium	mg/l		ND	0.0014	0.005
PZ-37D	5/13/2021	7782-49-2	Selenium	mg/l		ND	0.0016	0.005
YGWC-22S	7/5/2017	7782-49-2	Selenium	mg/l	0.0147		0.0018	0.01
YGWC-22S	5/2/2017	7782-49-2	Selenium	mg/l	0.0149		0.0014	0.01
YGWC-22S	3/8/2017	7782-49-2	Selenium	mg/l	0.0171		0.0014	0.01
YGWC-22S	1/16/2017	7782-49-2	Selenium	mg/l	0.0172		0.001	0.01
YGWC-22S	11/9/2016	7782-49-2	Selenium	mg/l	0.0209		0.001	0.01
YGWC-22S	9/19/2016	7782-49-2	Selenium	mg/l	0.0237		0.001	0.01
YGWC-22S	7/28/2016	7782-49-2	Selenium	mg/l	0.0224		0.0009	0.01
YGWC-22S	6/7/2016	7782-49-2	Selenium	mg/l	0.025		0.00024	0.0013
YGWC-34I	7/10/2017	7782-49-2	Selenium	mg/l	0.0773		0.0018	0.01
YGWC-34I	5/2/2017	7782-49-2	Selenium	mg/l	0.0734		0.0014	0.01
YGWC-34I	2/28/2017	7782-49-2	Selenium	mg/l	0.0827		0.0014	0.01
YGWC-34I	1/17/2017	7782-49-2	Selenium	mg/l	0.0758		0.001	0.01
YGWC-34I	11/9/2016	7782-49-2	Selenium	mg/l	0.0814		0.001	0.01
YGWC-34I	9/21/2016	7782-49-2	Selenium	mg/l	0.0746		0.001	0.01
YGWC-34I	7/28/2016	7782-49-2	Selenium	mg/l	0.0748		0.0009	0.01
YGWC-34I	6/8/2016	7782-49-2	Selenium	mg/l	0.06		0.00024	0.0013
YGWC-32I	7/11/2017	7782-49-2	Selenium	mg/l	0.0046	J	0.0018	0.01
YGWC-32I	5/3/2017	7782-49-2	Selenium	mg/l	0.0022	J	0.0014	0.01
YGWC-32I	3/1/2017	7782-49-2	Selenium	mg/l	0.0042	J	0.0014	0.01
YGWC-32I	1/17/2017	7782-49-2	Selenium	mg/l	0.0027	J	0.001	0.01
YGWC-32I	11/10/2016	7782-49-2	Selenium	mg/l	0.0016	J	0.001	0.01
YGWC-32I	9/21/2016	7782-49-2	Selenium	mg/l	0.0026	J	0.001	0.01
YGWC-32I	7/29/2016	7782-49-2	Selenium	mg/l	0.002	J	0.0009	0.01
YGWC-32I	6/8/2016	7782-49-2	Selenium	mg/l	0.00094	J	0.00024	0.0013
YGWC-32S	7/11/2017	7782-49-2	Selenium	mg/l	0.0696		0.0018	0.01

Appendix B
Site Groundwater Data (2016-2022) for Evaluation of SSLs
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Well	Date	CAS	Constituent	Units	Obs	Flags	MDL	PQL
YGWC-32S	5/3/2017	7782-49-2	Selenium	mg/l	0.0716		0.0014	0.01
YGWC-32S	3/1/2017	7782-49-2	Selenium	mg/l	0.0704		0.0014	0.01
YGWC-32S	1/17/2017	7782-49-2	Selenium	mg/l	0.0635		0.001	0.01
YGWC-32S	11/9/2016	7782-49-2	Selenium	mg/l	0.0531		0.001	0.01
YGWC-32S	9/21/2016	7782-49-2	Selenium	mg/l	0.0458		0.001	0.01
YGWC-32S	7/29/2016	7782-49-2	Selenium	mg/l	0.0403		0.0009	0.01
YGWC-32S	6/8/2016	7782-49-2	Selenium	mg/l	0.032		0.00024	0.0013
PZ-52D	2/11/2022	7782-49-2	Selenium	mg/l	0.0025	J	0.0014	0.005
PZ-52D	11/4/2021	7782-49-2	Selenium	mg/l	0.0034	J	0.0014	0.005
PZ-35	2/10/2022	7782-49-2	Selenium	mg/l	0.003	J	0.0014	0.005
PZ-35	9/1/2021	7782-49-2	Selenium	mg/l	0.0016	J	0.0014	0.005
PZ-35	3/4/2021	7782-49-2	Selenium	mg/l		ND	0.0016	0.005
PZ-35	2/10/2021	7782-49-2	Selenium	mg/l		ND	0.0016	0.01
PZ-35	9/24/2020	7782-49-2	Selenium	mg/l		ND	0.0016	0.01
PZ-35	3/25/2020	7782-49-2	Selenium	mg/l		ND	0.0013	0.01
PZ-35	9/26/2019	7782-49-2	Selenium	mg/l		ND	0.0025	0.00008
PZ-35	10/16/2018	7782-49-2	Selenium	mg/l		ND	0.01	0.01
YGWC-36A	2/11/2022	7782-49-2	Selenium	mg/l		ND	0.0014	0.005
YGWC-36A	9/3/2021	7782-49-2	Selenium	mg/l		ND	0.0014	0.005
YGWC-36A	3/4/2021	7782-49-2	Selenium	mg/l		ND	0.0016	0.005
YGWC-36A	2/10/2021	7782-49-2	Selenium	mg/l		ND	0.0016	0.01
YGWC-36A	10/7/2020	7782-49-2	Selenium	mg/l		ND	0.0016	0.01
YGWC-36	3/25/2020	7782-49-18	Selenium	mg/l	0.0024	J	0.0013	0.01
YGWC-36	2/14/2020	7782-49-17	Selenium	mg/l	0.002	J	0.0013	0.01
YGWC-36	9/26/2019	7782-49-16	Selenium	mg/l	0.0019	J	0.0013	0.01
YGWC-36	4/4/2019	7782-49-15	Selenium	mg/l	0.0029	J	0.0014	0.01
YGWC-36	3/6/2019	7782-49-14	Selenium	mg/l	0.0033	J	0.0014	0.01
YGWC-36	9/26/2018	7782-49-13	Selenium	mg/l	0.0037	J	0.0014	0.01
YGWC-36	6/13/2018	7782-49-12	Selenium	mg/l	0.0024	J	0.0014	0.01
YGWC-36	3/30/2018	7782-49-11	Selenium	mg/l		ND	0.01	0.01
YGWC-36	10/6/2017	7782-49-10	Selenium	mg/l		ND	0.01	0.01
YGWC-36	9/29/2017	7782-49-9	Selenium	mg/l	0.002	J	0.0018	0.01
YGWC-36	9/22/2017	7782-49-8	Selenium	mg/l	0.0024	J	0.0018	0.01
YGWC-36	7/13/2017	7782-49-7	Selenium	mg/l	0.0031	J	0.0018	0.01
YGWC-36	5/9/2017	7782-49-6	Selenium	mg/l	0.0018	J	0.0014	0.01
YGWC-36	2/28/2017	7782-49-5	Selenium	mg/l	0.0017	J	0.0014	0.01
YGWC-36	11/14/2016	7782-49-4	Selenium	mg/l		ND	0.05	0.05
YGWC-36	9/2/2016	7782-49-3	Selenium	mg/l	0.0012	J	0.001	0.01
YAMW-1	2/10/2022	7782-49-2	Selenium	mg/l	0.0034	J	0.0014	0.005
YAMW-1	9/1/2021	7782-49-2	Selenium	mg/l	0.0027	J	0.0014	0.005
YAMW-1	3/3/2021	7782-49-2	Selenium	mg/l		ND	0.0016	0.005
YAMW-1	2/9/2021	7782-49-2	Selenium	mg/l		ND	0.0016	0.01
YAMW-1	9/24/2020	7782-49-2	Selenium	mg/l		ND	0.0016	0.01
YAMW-1	3/25/2020	7782-49-2	Selenium	mg/l		ND	0.0013	0.01
YAMW-1	9/26/2019	7782-49-2	Selenium	mg/l		ND	0.0025	0.00008
YAMW-1	10/16/2018	7782-49-2	Selenium	mg/l	0.0019	J	0.0014	0.01
YGWC-26I	2/10/2022	7782-49-2	Selenium	mg/L	0.0042	J	0.0014	0.005
YGWC-26I	8/20/2021	7782-49-2	Selenium	mg/L	0.0026	J	0.0014	0.005
YGWC-26I	3/3/2021	7782-49-2	Selenium	mg/L	0.0034	J	0.0016	0.005
YGWC-26I	2/10/2021	7782-49-2	Selenium	mg/L	0.0026	J	0.0016	0.01
YGWC-26I	9/24/2020	7782-49-2	Selenium	mg/L	0.0031	J	0.0016	0.01

Appendix B
Site Groundwater Data (2016-2022) for Evaluation of SSLs
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Well	Date	CAS	Constituent	Units	Obs	Flags	MDL	PQL
YGWC-26I	3/20/2020	7782-49-2	Selenium	mg/L	0.0019	J	n/a	n/a
YGWC-26I	2/13/2020	7782-49-2	Selenium	mg/L	0.0019	J	n/a	n/a
YGWC-26I	9/25/2019	7782-49-2	Selenium	mg/L	0.0019	J	0.0013	0.01
YGWC-26I	4/2/2019	7782-49-2	Selenium	mg/L	0.0017	J	0.0014	0.01
YGWC-26I	2/27/2019	7782-49-2	Selenium	mg/L	0.002	J	0.0014	0.01
YGWC-26I	3/30/2018	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26I	7/10/2017	7782-49-2	Selenium	mg/L	0.002	J	0.0018	0.01
YGWC-26I	5/8/2017	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26I	2/21/2017	7782-49-2	Selenium	mg/L	0.0018	J	0.001	0.01
YGWC-26I	1/18/2017	7782-49-2	Selenium	mg/L	0.002	J	0.001	0.01
YGWC-26I	11/7/2016	7782-49-2	Selenium	mg/L	0.0017	J	0.001	0.01
YGWC-26I	9/20/2016	7782-49-2	Selenium	mg/L	0.0022	J	0.001	0.01
YGWC-26I	8/1/2016	7782-49-2	Selenium	mg/L	0.0023	J	0.0009	0.01
YGWC-26I	6/8/2016	7782-49-2	Selenium	mg/L	0.0016		0.00024	0.0013
YGWC-26S	2/10/2022	7782-49-2	Selenium	mg/L		ND	0.0014	0.005
YGWC-26S	8/19/2021	7782-49-2	Selenium	mg/L		ND	0.0014	0.005
YGWC-26S	3/2/2021	7782-49-2	Selenium	mg/L		ND	0.0016	0.005
YGWC-26S	2/10/2021	7782-49-2	Selenium	mg/L		ND	0.0016	0.01
YGWC-26S	9/24/2020	7782-49-2	Selenium	mg/L		ND	0.0016	0.01
YGWC-26S	3/19/2020	7782-49-2	Selenium	mg/L		ND	0.0013	0.01
YGWC-26S	2/13/2020	7782-49-2	Selenium	mg/L		ND	n/a	0.01
YGWC-26S	9/25/2019	7782-49-2	Selenium	mg/L		ND	n/a	0.01
YGWC-26S	4/2/2019	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26S	2/27/2019	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26S	3/30/2018	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26S	7/10/2017	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26S	5/3/2017	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26S	2/21/2017	7782-49-2	Selenium	mg/L	0.0014	J	0.001	0.01
YGWC-26S	1/18/2017	7782-49-2	Selenium	mg/L	0.0012	J	0.001	0.01
YGWC-26S	11/7/2016	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26S	9/20/2016	7782-49-2	Selenium	mg/L		ND	0.01	0.01
YGWC-26S	8/1/2016	7782-49-2	Selenium	mg/L	0.0014	J	0.0009	0.01
YGWC-26S	6/8/2016	7782-49-2	Selenium	mg/L	0.0003	J	0.00024	0.0013

Notes:
J - indicates an estimated value; the substance was detected between the laboratory MDL and PQL.
MDL - method detection limit
mg/L - milligrams per liter
n/a - not available
ND - not detected above the laboratory MDL
PQL - practical quantitation limit

Prepared By/Date: JHG 04/28/22
Checked By/Date: IRM 04/28/22

APPENDIX C

USEPA RSL Calculator Generated Residential Screening Levels

Appendix C-1
Yates R6-AMA
Plant Yates, Coweta County, GA

Variable	Value
THQ (target hazard quotient) unitless	1
TR (target risk) unitless	0.00001
LT (lifetime) years	70
K (volatilization factor of Andelman) L/m^3	0.5
I_{sc} (apparent thickness of stratum corneum) cm	0.001
ED_{res} (exposure duration - resident) years	26
ED_{res-c} (exposure duration - child) years	6
ED_{res-a} (exposure duration - adult) years	20
ED_{0-2} (mutagenic exposure duration first phase) years	2
ED_{2-6} (mutagenic exposure duration second phase) years	4
ED_{6-16} (mutagenic exposure duration third phase) years	10
ED_{16-26} (mutagenic exposure duration fourth phase) years	10
EF_{res} (exposure frequency) days/year	350
EF_{res-c} (exposure frequency - child) days/year	350
EF_{res-a} (exposure frequency - adult) days/year	350
EF_{0-2} (mutagenic exposure frequency first phase) days/year	350
EF_{2-6} (mutagenic exposure frequency second phase) days/year	350
EF_{6-16} (mutagenic exposure frequency third phase) days/year	350
EF_{16-26} (mutagenic exposure frequency fourth phase) days/year	350
$ET_{event-res-adj}$ (age-adjusted exposure time) hours/event	0.67077
$ET_{event-res-madj}$ (mutagenic age-adjusted exposure time) hours/event	0.67077
ET_{res} (exposure time) hours/day	24
ET_{res-c} (dermal exposure time - child) hours/event	0.54
ET_{res-a} (dermal exposure time - adult) hours/event	0.71
ET_{res-c} (inhalation exposure time - child) hours/day	24
ET_{res-a} (inhalation exposure time - adult) hours/day	24
Appendix D-3	24
Scherer AP-1	24
Plant Scherer, Juliette, GA	24
ET_{16-26} (mutagenic inhalation exposure time fourth phase) hours/day	24
ET_{0-2} (mutagenic dermal exposure time first phase) hours/event	0.54
ET_{2-6} (mutagenic dermal exposure time second phase) hours/event	0.54
ET_{6-16} (mutagenic dermal exposure time third phase) hours/event	0.71
ET_{16-26} (mutagenic dermal exposure time fourth phase) hours/event	0.71
BW_{res-a} (body weight - adult) kg	80

Appendix C-1
Yates R6-AMA
Plant Yates, Coweta County, GA

Variable	Value
$BW_{res\text{-}c}$ (body weight - child) kg	15
$BW_{0\text{-}2}$ (mutagenic body weight) kg	15
$BW_{2\text{-}6}$ (mutagenic body weight) kg	15
$BW_{6\text{-}16}$ (mutagenic body weight) kg	80
$BW_{16\text{-}26}$ (mutagenic body weight) kg	80
$IFW_{res\text{-}adj}$ (adjusted intake factor) L/kg	327.95
$IFW_{res\text{-}adj}$ (adjusted intake factor) L/kg	327.95
$IFWM_{res\text{-}adj}$ (mutagenic adjusted intake factor) L/kg	1019.9
$IFWM_{res\text{-}adj}$ (mutagenic adjusted intake factor) L/kg	1019.9
$IRW_{res\text{-}c}$ (water intake rate - child) L/day	0.78
$IRW_{res\text{-}a}$ (water intake rate - adult) L/day	2.5
$IRW_{0\text{-}2}$ (mutagenic water intake rate) L/day	0.78
$IRW_{2\text{-}6}$ (mutagenic water intake rate) L/day	0.78
$IRW_{6\text{-}16}$ (mutagenic water intake rate) L/day	2.5
$IRW_{16\text{-}26}$ (mutagenic water intake rate) L/day	2.5
$EV_{res\text{-}a}$ (events - adult) per day	1
$EV_{res\text{-}c}$ (events - child) per day	1
$EV_{0\text{-}2}$ (mutagenic events) per day	1
$EV_{2\text{-}6}$ (mutagenic events) per day	1
$EV_{6\text{-}16}$ (mutagenic events) per day	1
$EV_{16\text{-}26}$ (mutagenic events) per day	1
$DFW_{res\text{-}adj}$ (age-adjusted dermal factor) cm^2-event/kg	2610650
$DFWM_{res\text{-}adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8191633
$SA_{res\text{-}c}$ (skin surface area - child) cm^2	6365
$SA_{res\text{-}a}$ (skin surface area - adult) cm^2	19652
$SA_{0\text{-}2}$ (mutagenic skin surface area) cm^2	6365
$SA_{2\text{-}6}$ (mutagenic skin surface area) cm^2	6365
$SA_{6\text{-}16}$ (mutagenic skin surface area) cm^2	19652
$SA_{16\text{-}26}$ (mutagenic skin surface area) cm^2	19652

Output generated 28APR2022:14:18:58

Appendix C-2
Default
Resident Risk-Based Regional Screening Levels (RSL) for Tap Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o $(mg/kg\text{-}day)^{-1}$	SF_o Ref	IUR $(ug/m^3)^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref
Beryllium and compounds	7440-41-7	No	No	Inorganics	-		2.40E-03	I	2.00E-03	I	2.00E-05	I
Selenium	7782-49-2	No	No	Inorganics	-		-		5.00E-03	I	2.00E-02	C

Output generated 28APR2022:14:18:58

Appendix C-2
Default
Resident Risk-Based Regional Screening Levels (RSL) for Tap Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	GIABS	K_p (cm/hr)	MW	B (unitless)	t^* (hr)	τ_{event} (hr/event)	FA (unitless)
Beryllium and compounds	7440-41-7	No	No	Inorganics	7.00E-03	1.00E-03	9.01E+00	1.15E-03	2.83E-01	1.18E-01	1.00E+00
Selenium	7782-49-2	No	No	Inorganics	1.00E+00	1.00E-03	7.90E+01	3.42E-03	6.99E-01	2.91E-01	1.00E+00

Output generated 28APR2022:14:18:58

Appendix C-2
Default
Resident Risk-Based Regional Screening Levels (RSL) for Tap Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	In EPD?	$DA_{event (ca)}$	$DA_{event (nc child)}$	$DA_{event (nc adult)}$	MCL (ug/L)	Ingestion SL TR=1E-05 (ug/L)
Beryllium and compounds	7440-41-7	No	No	Inorganics	Yes	-	3.44E-05	5.94E-05	4.00E+00	-
Selenium	7782-49-2	No	No	Inorganics	Yes	-	1.23E-02	2.12E-02	5.00E+01	-

Output generated 28APR2022:14:18:58

Appendix C-2
Default
Resident Risk-Based Regional Screening Levels (RSL) for Tap Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	Dermal SL TR=1E-05 (ug/L)	Inhalation SL TR=1E-05 (ug/L)	Carcinogenic SL TR=1E-05 (ug/L)	Ingestion SL Child THQ=1 (ug/L)
Beryllium and compounds	7440-41-7	No	No	Inorganics	-	-	-	4.01E+01
Selenium	7782-49-2	No	No	Inorganics	-	-	-	1.00E+02

Output generated 28APR2022:14:18:58

Appendix C-2
Default
Resident Risk-Based Regional Screening Levels (RSL) for Tap Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	Dermal SL Child THQ=1 (ug/L)	Inhalation SL Child THQ=1 (ug/L)	Noncarcinogenic SL Child THI=1 (ug/L)	Ingestion SL Adult THQ=1 (ug/L)
Beryllium and compounds	7440-41-7	No	No	Inorganics	6.37E+01	-	2.46E+01	6.67E+01
Selenium	7782-49-2	No	No	Inorganics	2.28E+04	-	9.98E+01	1.67E+02

Output generated 28APR2022:14:18:58

Appendix C-2
Default
Resident Risk-Based Regional Screening Levels (RSL) for Tap Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	Dermal SL Adult THQ=1 (ug/L)	Inhalation SL Adult THQ=1 (ug/L)	Noncarcinogenic SL Adult THI=1 (ug/L)	Screening Level (ug/L)
Beryllium and compounds	7440-41-7	No	No	Inorganics	8.37E+01	-	3.71E+01	2.46E+01 nc
Selenium	7782-49-2	No	No	Inorganics	2.99E+04	-	1.66E+02	9.98E+01 nc

Output generated 28APR2022:14:18:58

APPENDIX D

Support for Refined Risk Evaluation

Appendix D-1

Exposure Point Concentration Calculation Results

Appendix D-1
Exposure Point Concentration Calculation Results[1]
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

CCR Rule Designation	Constituent	Well IDs Included	Maximum Concentration (mg/L)	Detection Frequency	Exceedance Frequency	EPC Step 1 Individual Target Well(s) 2016-2022 (mg/L)	EPC Step 2 Target Well(s) & Downgradient Well(s) 2016-2022 (mg/L)	EPC Step 3 Farthest Downgradient Well(s) 2016-2022 (mg/L)
Appendix IV	Selenium	YGWC-38 PZ-37	0.33	30 / 30	24 / 30	0.27		
		YGWC-38 YAMW-5 YGWC-23S PZ-37 PZ-37D YGWC-22S YGWC-34I YGWC-32I YGWC-32S PZ-52D PZ-35 YGWC-36 YGWC-36A YAMW-1 YGWC-26S (AP-2) YGWC-26I (AP-2)	0.33	130 / 169	24 / 169		0.077	
		YGWC-26S (AP-2) YGWC-26I (AP-2)	0.0042	21 / 38	0 / 38			0.0024

Notes:
Highlighted value is the EPC selected for the refined screening.
1 - EPCs calculated in accordance with USEPA, 2014. Memorandum for Determining Groundwater Exposure Point Concentrations, Supplemental Guidance. OSWER Directive 9283.1-42, February 2014. Located at https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917

Definitions:
EPC = Exposure Point Concentration
mg/L = milligrams per liter

Prepared by/Date: IMR 04/27/22
Checked by/Date: LSV 04/27/22

Appendix D-2

Exposure Point Concentration Figures

Notes:
1. SHALLOW GROUNDWATER ELEVATION ARE DERIVED FROM SOIL COMPRISED OF SAPROLITE, RANGING FROM 15 - 60 FEET BELOW GROUND SURFACE
2. BEDROCK WELLS YGWA-40, YGWA-39, YGWC-38, YGWC-41, YGWC-42 USED FOR CONTOURING. ALL OTHER BEDROCK WELLS NOT USED TO CREATE CONTOURS.
3. SAPROLITE WELL GROUNDWATER ELEVATIONS WERE USED FOR CONTOURING FOR SAPROLITE/TRANSITION ZONE/BEDROCK WELL CLUSTER LOCATIONS.
4. ELEVATION IS PRESENTED IN U.S. SURVEY FEET (NAVD 1988)
5. GROUNDWATER ELEVATIONS COLLECTED ON FEBRUARY 7, 2022.

Plant Yates R6-AMA
Exposure Point Concentration for Selenium

Prepared By-Date: THP - 7/6/2022	wood.	Figure: D-2
Checked By-Date: IR - 7/6/2022		
Project Number: 6123201471		

Appendix D-3

ProUCL Input/Output Files

Appendix D-3a
Groundwater ProUCL Input - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Step 1

Well(1)	Date(1)	Selenium(1)	D_Selenium(1)
PZ-37	10/12/2017	0.234	1
PZ-37	11/21/2017	0.225	1
PZ-37	1/11/2018	0.168	1
PZ-37	2/20/2018	0.315	1
PZ-37	4/3/2018	0.28	1
PZ-37	6/29/2018	0.26	1
PZ-37	8/6/2018	0.21	1
PZ-37	9/24/2018	0.33	1
PZ-37	9/25/2020	0.32	1
PZ-37	2/9/2021	0.28	1
PZ-37	3/4/2021	0.27	1
PZ-37	8/25/2021	0.2	1
PZ-37	2/10/2022	0.2	1
YGWC-38	10/12/2017	0.265	1
YGWC-38	11/20/2017	0.246	1
YGWC-38	1/12/2018	0.249	1
YGWC-38	2/20/2018	0.253	1
YGWC-38	4/3/2018	0.23	1
YGWC-38	6/28/2018	0.23	1
YGWC-38	8/7/2018	0.2	1
YGWC-38	9/24/2018	0.2	1
YGWC-38	8/22/2019	0.14	1
YGWC-38	10/9/2019	0.12	1
YGWC-38	2/14/2020	0.11	1
YGWC-38	3/25/2020	0.099	1
YGWC-38	9/25/2020	0.076	1
YGWC-38	2/9/2021	0.073	1
YGWC-38	3/4/2021	0.076	1
YGWC-38	8/26/2021	0.06	1
YGWC-38	2/10/2022	0.064	1

Step 2

Well(2)	Date(2)	Selenium(2)	D_Selenium(2)
PZ-35	10/16/2018	0.01	0
PZ-35	9/26/2019	0.00008	0
PZ-35	3/25/2020	0.01	0
PZ-35	9/24/2020	0.01	0
PZ-35	2/10/2021	0.01	0
PZ-35	3/4/2021	0.005	0
PZ-35	9/1/2021	0.0016	1
PZ-35	2/10/2022	0.003	1
PZ-37	10/12/2017	0.234	1
PZ-37	11/21/2017	0.225	1
PZ-37	1/11/2018	0.168	1
PZ-37	2/20/2018	0.315	1
PZ-37	04/03/18	0.28	1
PZ-37	06/29/18	0.26	1
PZ-37	08/06/18	0.21	1
PZ-37	09/24/18	0.33	1
PZ-37	09/25/20	0.32	1
PZ-37	02/09/21	0.28	1
PZ-37	03/04/21	0.27	1
PZ-37	08/25/21	0.2	1
PZ-37	02/10/22	0.2	1
PZ-37D	05/13/21	0.005	0
PZ-37D	09/03/21	0.005	0
PZ-37D	02/11/22	0.005	0
PZ-52D	11/04/21	0.0034	1
PZ-52D	02/11/22	0.0025	1
YAMW-1	10/16/18	0.0019	1
YAMW-1	09/26/19	0.00008	0
YAMW-1	03/25/20	0.01	0
YAMW-1	09/24/20	0.01	0
YAMW-1	02/09/21	0.01	0
YAMW-1	03/03/21	0.005	0
YAMW-1	09/01/21	0.0027	1
YAMW-1	02/10/22	0.0034	1
YAMW-5	01/15/20	0.045	1
YAMW-5	09/24/20	0.026	1
YAMW-5	02/09/21	0.06	1
YAMW-5	03/04/21	0.061	1
YAMW-5	08/26/21	0.055	1
YAMW-5	02/10/22	0.057	1
YGWC-22S	06/07/16	0.025	1
YGWC-22S	07/28/16	0.0224	1
YGWC-22S	09/19/16	0.0237	1
YGWC-22S	11/09/16	0.0209	1
YGWC-22S	01/16/17	0.0172	1
YGWC-22S	03/08/17	0.0171	1
YGWC-22S	05/02/17	0.0149	1
YGWC-22S	07/05/17	0.0147	1
YGWC-23S	06/07/16	0.037	1
YGWC-23S	07/28/16	0.0385	1
YGWC-23S	09/20/16	0.0464	1
YGWC-23S	11/08/16	0.0521	1
YGWC-23S	01/16/17	0.0469	1
YGWC-23S	03/09/17	0.0437	1
YGWC-23S	05/02/17	0.0395	1
YGWC-23S	07/10/17	0.0386	1
YGWC-23S	03/30/18	0.028	1
YGWC-23S	06/12/18	0.026	1
YGWC-23S	09/27/18	0.023	1
YGWC-23S	03/06/19	0.019	1
YGWC-23S	04/04/19	0.017	1
YGWC-23S	09/27/19	0.018	1
YGWC-23S	02/17/20	0.02	1
YGWC-23S	03/26/20	0.024	1
YGWC-23S	09/24/20	0.031	1
YGWC-23S	02/09/21	0.032	1
YGWC-23S	03/04/21	0.037	1
YGWC-23S	08/25/21	0.032	1

Step 3

Well(3)	Date(3)	Selenium(3)	D_Selenium(3)
YGWC-26I	6/8/2016	0.0016	1
YGWC-26I	8/1/2016	0.0023	1
YGWC-26I	9/20/2016	0.0022	1
YGWC-26I	11/7/2016	0.0017	1
YGWC-26I	1/18/2017	0.002	1
YGWC-26I	2/21/2017	0.0018	1
YGWC-26I	5/8/2017	0.01	0
YGWC-26I	7/10/2017	0.002	1
YGWC-26I	3/30/2018	0.01	0
YGWC-26I	2/27/2019	0.002	1
YGWC-26I	4/2/2019	0.0017	1
YGWC-26I	9/25/2019	0.0019	1
YGWC-26I	2/13/2020	0.0019	1
YGWC-26I	3/20/2020	0.0019	1
YGWC-26I	9/24/2020	0.0031	1
YGWC-26I	2/10/2021	0.0026	1
YGWC-26I	3/3/2021	0.0034	1
YGWC-26I	8/20/2021	0.0026	1
YGWC-26I	2/10/2022	0.0042	1
YGWC-26S	6/8/2016	0.0003	1
YGWC-26S	8/1/2016	0.0014	1
YGWC-26S	9/20/2016	0.01	0
YGWC-26S	11/7/2016	0.01	0
YGWC-26S	1/18/2017	0.0012	1
YGWC-26S	2/21/2017	0.0014	1
YGWC-26S	5/3/2017	0.01	0
YGWC-26S	7/10/2017	0.01	0
YGWC-26S	3/30/2018	0.01	0
YGWC-26S	2/27/2019	0.01	0
YGWC-26S	4/2/2019	0.01	0
YGWC-26S	9/25/2019	0.01	0
YGWC-26S	2/13/2020	0.01	0
YGWC-26S	3/19/2020	0.01	0
YGWC-26S	9/24/2020	0.01	0
YGWC-26S	2/10/2021	0.01	0
YGWC-26S	3/2/2021	0.005	0
YGWC-26S	8/19/2021	0.005	0
YGWC-26S	2/10/2022	0.005	0

Appendix D-3a
Groundwater ProUCL Input - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Step 1

Well(1)	Date(1)	Selenium(1)	D_Selenium(1)

Step 2

Well(2)	Date(2)	Selenium(2)	D_Selenium(2)
YGWC-23S	02/10/22	0.039	1
YGWC-26I	06/08/16	0.0016	1
YGWC-26I	08/01/16	0.0023	1
YGWC-26I	09/20/16	0.0022	1
YGWC-26I	11/07/16	0.0017	1
YGWC-26I	01/18/17	0.002	1
YGWC-26I	02/21/17	0.0018	1
YGWC-26I	05/08/17	0.01	0
YGWC-26I	07/10/17	0.002	1
YGWC-26I	03/30/18	0.01	0
YGWC-26I	02/27/19	0.002	1
YGWC-26I	04/02/19	0.0017	1
YGWC-26I	09/25/19	0.0019	1
YGWC-26I	02/13/20	0.0019	1
YGWC-26I	03/20/20	0.0019	1
YGWC-26I	09/24/20	0.0031	1
YGWC-26I	02/10/21	0.0026	1
YGWC-26I	03/03/21	0.0034	1
YGWC-26I	08/20/21	0.0026	1
YGWC-26I	02/10/22	0.0042	1
YGWC-26S	06/08/16	0.0003	1
YGWC-26S	08/01/16	0.0014	1
YGWC-26S	09/20/16	0.01	0
YGWC-26S	11/07/16	0.01	0
YGWC-26S	01/18/17	0.0012	1
YGWC-26S	02/21/17	0.0014	1
YGWC-26S	05/03/17	0.01	0
YGWC-26S	07/10/17	0.01	0
YGWC-26S	03/30/18	0.01	0
YGWC-26S	02/27/19	0.01	0
YGWC-26S	04/02/19	0.01	0
YGWC-26S	09/25/19	0.01	0
YGWC-26S	02/13/20	0.01	0
YGWC-26S	03/19/20	0.01	0
YGWC-26S	09/24/20	0.01	0
YGWC-26S	02/10/21	0.01	0
YGWC-26S	03/02/21	0.005	0
YGWC-26S	08/19/21	0.005	0
YGWC-26S	02/10/22	0.005	0
YGWC-32I	06/08/16	0.00094	1
YGWC-32I	07/29/16	0.002	1
YGWC-32I	09/21/16	0.0026	1
YGWC-32I	11/10/16	0.0016	1
YGWC-32I	01/17/17	0.0027	1
YGWC-32I	03/01/17	0.0042	1
YGWC-32I	05/03/17	0.0022	1
YGWC-32I	07/11/17	0.0046	1
YGWC-32S	06/08/16	0.032	1
YGWC-32S	07/29/16	0.0403	1
YGWC-32S	09/21/16	0.0458	1
YGWC-32S	11/09/16	0.0531	1
YGWC-32S	01/17/17	0.0635	1
YGWC-32S	03/01/17	0.0704	1
YGWC-32S	05/03/17	0.0716	1
YGWC-32S	07/11/17	0.0696	1
YGWC-34I	06/08/16	0.06	1
YGWC-34I	07/28/16	0.0748	1
YGWC-34I	09/21/16	0.0746	1
YGWC-34I	11/09/16	0.0814	1
YGWC-34I	01/17/17	0.0758	1
YGWC-34I	02/28/17	0.0827	1
YGWC-34I	05/02/17	0.0734	1
YGWC-34I	07/10/17	0.0773	1
YGWC-36	09/02/16	0.0012	1
YGWC-36	11/14/16	0.05	0
YGWC-36	02/28/17	0.0017	1
YGWC-36	05/09/17	0.0018	1
YGWC-36	07/13/17	0.0031	1
YGWC-36	09/22/17	0.0024	1
YGWC-36	09/29/17	0.002	1
YGWC-36	10/06/17	0.01	0
YGWC-36	03/30/18	0.01	0
YGWC-36	06/13/18	0.0024	1
YGWC-36	09/26/18	0.0037	1
YGWC-36	03/06/19	0.0033	1
YGWC-36	04/04/19	0.0029	1
YGWC-36	09/26/19	0.0019	1
YGWC-36	02/14/20	0.002	1
YGWC-36	03/25/20	0.0024	1

Step 3

Well(3)	Date(3)	Selenium(3)	D_Selenium(3)

Appendix D-3a
Groundwater ProUCL Input - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Step 1

Well(1)	Date(1)	Selenium(1)	D_Selenium(1)

Notes:
1) Concentrations in units of mg/L.

Step 2

Well(2)	Date(2)	Selenium(2)	D_Selenium(2)
YGWC-36A	10/07/20	0.01	0
YGWC-36A	02/10/21	0.01	0
YGWC-36A	03/04/21	0.005	0
YGWC-36A	09/03/21	0.005	0
YGWC-36A	02/11/22	0.005	0
YGWC-38	10/12/17	0.265	1
YGWC-38	11/20/17	0.246	1
YGWC-38	01/12/18	0.249	1
YGWC-38	02/20/18	0.253	1
YGWC-38	04/03/18	0.23	1
YGWC-38	06/28/18	0.23	1
YGWC-38	08/07/18	0.2	1
YGWC-38	09/24/18	0.2	1
YGWC-38	08/22/19	0.14	1
YGWC-38	10/09/19	0.12	1
YGWC-38	02/14/20	0.11	1
YGWC-38	03/25/20	0.099	1
YGWC-38	09/25/20	0.076	1
YGWC-38	02/09/21	0.073	1
YGWC-38	03/04/21	0.076	1
YGWC-38	08/26/21	0.06	1
YGWC-38	02/10/22	0.064	1

Step 3

Well(3)	Date(3)	Selenium(3)	D_Selenium(3)

Prepared by/Date: IMR 04/27/2022
Checked by/Date: LSV 04/27/22

Appendix D-3b
Groundwater ProUCL Output - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.14/27/2022 1:28:01 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Selenium(1)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	24
		Number of Missing Observations	0
Minimum	0.06	Mean	0.199
Maximum	0.33	Median	0.218
SD	0.0821	Std. Error of Mean	0.015
Coefficient of Variation	0.412	Skewness	-0.37

Normal GOF Test

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.169	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.159	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.225	95% Adjusted-CLT UCL (Chen-1995)	0.223
		95% Modified-t UCL (Johnson-1978)	0.225

Gamma GOF Test

A-D Test Statistic	1.386	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.231	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.16	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix D-3b
Groundwater ProUCL Output - Selenium
Yates Risk Evaluation Report
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Gamma Statistics

k hat (MLE)	4.654	k star (bias corrected MLE)	4.211
Theta hat (MLE)	0.0429	Theta star (bias corrected MLE)	0.0474
nu hat (MLE)	279.2	nu star (bias corrected)	252.6
MLE Mean (bias corrected)	0.199	MLE Sd (bias corrected)	0.0972
		Approximate Chi Square Value (0.05)	216.8
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	214.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.232	95% Adjusted Gamma UCL (use when n<50)	0.234

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.253	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.159	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.813	Mean of logged Data	-1.724
Maximum of Logged Data	-1.109	SD of logged Data	0.521

Assuming Lognormal Distribution

95% H-UCL	0.247	90% Chebyshev (MVUE) UCL	0.264
95% Chebyshev (MVUE) UCL	0.292	97.5% Chebyshev (MVUE) UCL	0.33
99% Chebyshev (MVUE) UCL	0.405		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.224	95% Jackknife UCL	0.225
95% Standard Bootstrap UCL	0.224	95% Bootstrap-t UCL	0.224
95% Hall's Bootstrap UCL	0.223	95% Percentile Bootstrap UCL	0.222
95% BCA Bootstrap UCL	0.222		
90% Chebyshev(Mean, Sd) UCL	0.244	95% Chebyshev(Mean, Sd) UCL	0.265
97.5% Chebyshev(Mean, Sd) UCL	0.293	99% Chebyshev(Mean, Sd) UCL	0.349

Appendix D-3b
Groundwater ProUCL Output - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	0.265

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Selenium(2)

General Statistics

Total Number of Observations	169	Number of Distinct Observations	96
Number of Detects	130	Number of Non-Detects	39
Number of Distinct Detects	92	Number of Distinct Non-Detects	4
Minimum Detect	3.0000E-4	Minimum Non-Detect	8.0000E-5
Maximum Detect	0.33	Maximum Non-Detect	0.05
Variance Detects	0.00757	Percent Non-Detects	23.08%
Mean Detects	0.0638	SD Detects	0.087
Median Detects	0.027	CV Detects	1.364
Skewness Detects	1.625	Kurtosis Detects	1.467
Mean of Logged Detects	-3.999	SD of Logged Detects	1.847

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.71	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0781	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0496	KM Standard Error of Mean	0.0062
KM SD	0.0803	95% KM (BCA) UCL	0.06
95% KM (t) UCL	0.0599	95% KM (Percentile Bootstrap) UCL	0.0595
95% KM (z) UCL	0.0598	95% KM Bootstrap t UCL	0.0615
90% KM Chebyshev UCL	0.0682	95% KM Chebyshev UCL	0.0766
97.5% KM Chebyshev UCL	0.0883	99% KM Chebyshev UCL	0.111

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.635	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.818	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.171	**Kolmogorov-Smirnov GOF**

Appendix D-3b
Groundwater ProUCL Output - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

5% K-S Critical Value	0.0864	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.508	k star (bias corrected MLE)	0.502
Theta hat (MLE)	0.125	Theta star (bias corrected MLE)	0.127
nu hat (MLE)	132.2	nu star (bias corrected)	130.4
Mean (detects)	0.0638		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	3.0000E-4	Mean	0.0515
Maximum	0.33	Median	0.0129
SD	0.0795	CV	1.543
k hat (MLE)	0.54	k star (bias corrected MLE)	0.534
Theta hat (MLE)	0.0953	Theta star (bias corrected MLE)	0.0964
nu hat (MLE)	182.6	nu star (bias corrected)	180.6
Adjusted Level of Significance (β)	0.0486		
Approximate Chi Square Value (180.64, α)	150.6	Adjusted Chi Square Value (180.64, β)	150.3
95% Gamma Approximate UCL (use when n>=50)	0.0618	95% Gamma Adjusted UCL (use when n<50)	0.0619

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0496	SD (KM)	0.0803
Variance (KM)	0.00645	SE of Mean (KM)	0.0062
k hat (KM)	0.381	k star (KM)	0.379
nu hat (KM)	128.9	nu star (KM)	128
theta hat (KM)	0.13	theta star (KM)	0.131
80% gamma percentile (KM)	0.0795	90% gamma percentile (KM)	0.141
95% gamma percentile (KM)	0.21	99% gamma percentile (KM)	0.383

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (127.97, α)	102.8	Adjusted Chi Square Value (127.97, β)	102.6
95% Gamma Approximate KM-UCL (use when n>=50)	0.0617	95% Gamma Adjusted KM-UCL (use when n<50)	0.0618

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.893	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	9.714E-14	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.165	**Lilliefors GOF Test**

Appendix D-3b
Groundwater ProUCL Output - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

5% Lilliefors Critical Value	0.0781	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.05	Mean in Log Scale	-4.472
SD in Original Scale	0.0803	SD in Log Scale	1.926
95% t UCL (assumes normality of ROS data)	0.0602	95% Percentile Bootstrap UCL	0.0606
95% BCA Bootstrap UCL	0.0617	95% Bootstrap t UCL	0.0617
95% H-UCL (Log ROS)	0.116		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.558	KM Geo Mean	0.0105
KM SD (logged)	1.975	95% Critical H Value (KM-Log)	3.167
KM Standard Error of Mean (logged)	0.157	95% H-UCL (KM -Log)	0.119
KM SD (logged)	1.975	95% Critical H Value (KM-Log)	3.167
KM Standard Error of Mean (logged)	0.157		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0501	Mean in Log Scale	-4.391
SD in Original Scale	0.0802	SD in Log Scale	1.85
95% t UCL (Assumes normality)	0.0603	95% H-Stat UCL	0.106

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.0766

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium(3)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	16
Number of Detects	21	Number of Non-Detects	17
Number of Distinct Detects	14	Number of Distinct Non-Detects	2
Minimum Detect	3.0000E-4	Minimum Non-Detect	0.005
Maximum Detect	0.0042	Maximum Non-Detect	0.01
Variance Detects	6.7257E-7	Percent Non-Detects	44.74%
Mean Detects	0.00206	SD Detects	8.2010E-4
Median Detects	0.0019	CV Detects	0.399

Appendix D-3b
Groundwater ProUCL Output - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Skewness Detects	0.691	Kurtosis Detects	1.9
Mean of Logged Detects	-6.284	SD of Logged Detects	0.516

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Detected Data Not Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00206	KM Standard Error of Mean	1.7896E-4
KM SD	8.0034E-4	95% KM (BCA) UCL	0.00238
95% KM (t) UCL	0.00236	95% KM (Percentile Bootstrap) UCL	0.00236
95% KM (z) UCL	0.00235	95% KM Bootstrap t UCL	0.0024
90% KM Chebyshev UCL	0.00259	95% KM Chebyshev UCL	0.00284
97.5% KM Chebyshev UCL	0.00317	99% KM Chebyshev UCL	0.00384

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.782	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.745	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.153	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.19	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.284	k star (bias corrected MLE)	4.561
Theta hat (MLE)	3.8933E-4	Theta star (bias corrected MLE)	4.5106E-4
nu hat (MLE)	221.9	nu star (bias corrected)	191.5
Mean (detects)	0.00206		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	3.0000E-4	Mean	0.00561
Maximum	0.01	Median	0.00325
SD	0.00405	CV	0.721
k hat (MLE)	1.575	k star (bias corrected MLE)	1.468
Theta hat (MLE)	0.00356	Theta star (bias corrected MLE)	0.00382
nu hat (MLE)	119.7	nu star (bias corrected)	111.6
Adjusted Level of Significance (β)	0.0434		

Appendix D-3b
Groundwater ProUCL Output - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

Approximate Chi Square Value (111.59, α)	88.21	Adjusted Chi Square Value (111.59, β)	87.35
95% Gamma Approximate UCL (use when n>=50)	0.0071	95% Gamma Adjusted UCL (use when n<50)	0.00717

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00206	SD (KM)	8.0034E-4
Variance (KM)	6.4054E-7	SE of Mean (KM)	1.7896E-4
k hat (KM)	6.607	k star (KM)	6.103
nu hat (KM)	502.1	nu star (KM)	463.8
theta hat (KM)	3.1138E-4	theta star (KM)	3.3709E-4
80% gamma percentile (KM)	0.00271	90% gamma percentile (KM)	0.00317
95% gamma percentile (KM)	0.00359	99% gamma percentile (KM)	0.00447

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (463.80, α)	414.9	Adjusted Chi Square Value (463.80, β)	413
95% Gamma Approximate KM-UCL (use when n>=50)	0.0023	95% Gamma Adjusted KM-UCL (use when n<50)	0.00231

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.797	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00204	Mean in Log Scale	-6.284
SD in Original Scale	8.1129E-4	SD in Log Scale	0.464
95% t UCL (assumes normality of ROS data)	0.00226	95% Percentile Bootstrap UCL	0.00225
95% BCA Bootstrap UCL	0.00226	95% Bootstrap t UCL	0.00228
95% H-UCL (Log ROS)	0.0024		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.284	KM Geo Mean	0.00187
KM SD (logged)	0.504	95% Critical H Value (KM-Log)	1.918
KM Standard Error of Mean (logged)	0.113	95% H-UCL (KM -Log)	0.00248
KM SD (logged)	0.504	95% Critical H Value (KM-Log)	1.918
KM Standard Error of Mean (logged)	0.113		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.00318	Mean in Log Scale	-5.898
SD in Original Scale	0.00154	SD in Log Scale	0.604

Appendix D-3b
Groundwater ProUCL Output - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA

95% t UCL (Assumes normality)	0.0036	95% H-Stat UCL	0.00402

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.00236

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

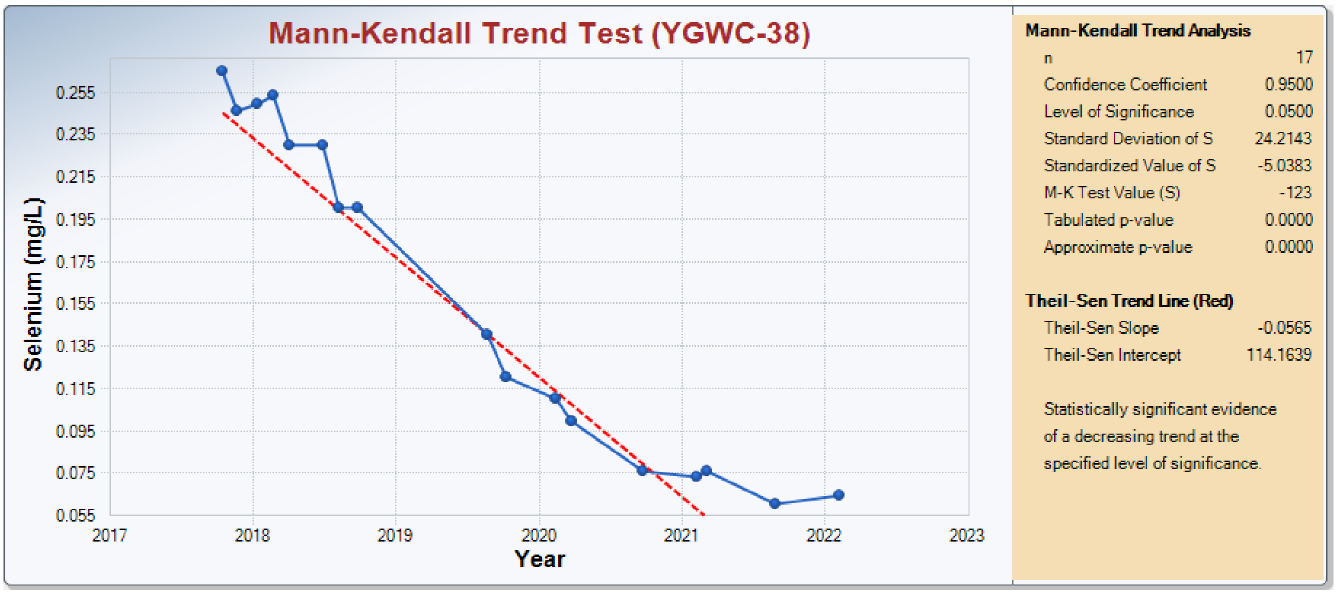
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

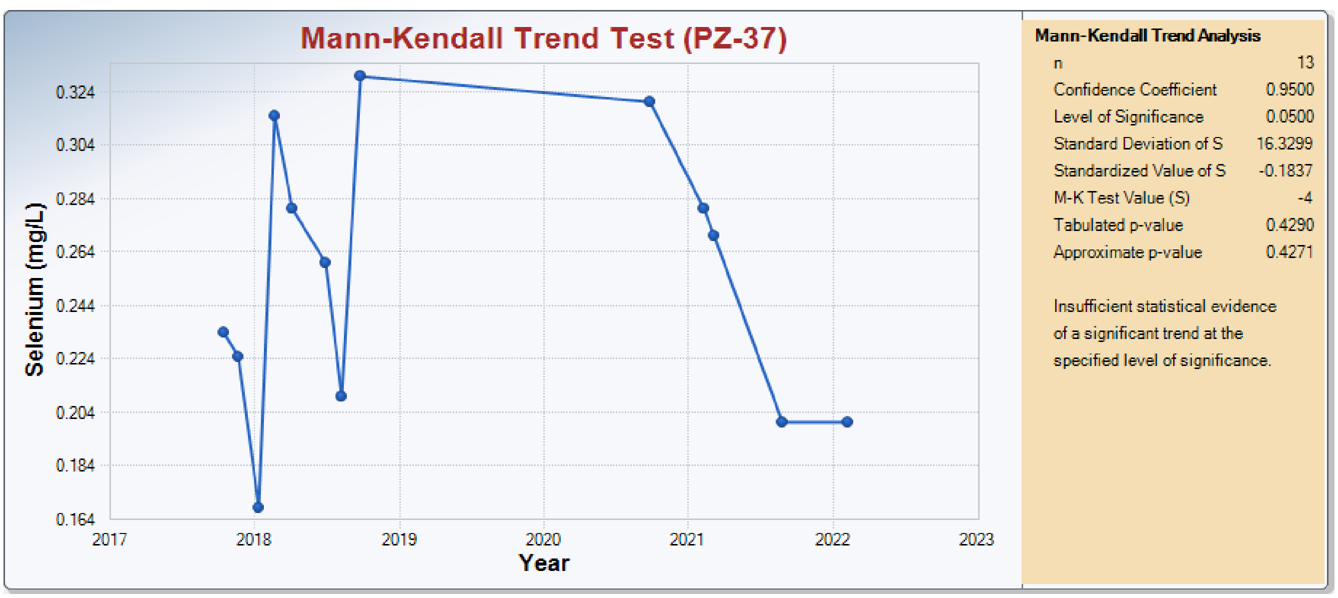
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix D-4

Groundwater Trend Graphs

Appendix D-4
Groundwater Mann-Kendall Trend Graphs - Selenium
Yates Risk Evaluation Report
Yates R6-AMA
Plant Yates, Coweta County, GA





Prepared by/Date: LO 05/02/22
Checked by/Date: IMR 05/02/22

Appendix E

Statistical Trend and Timeframe Analysis

PLANT YATES – STATISTICAL TREND ANALYIS OF SELENIUM

A statistical evaluation of selenium concentration trends, using a Mann-Kendall analysis, was performed on datasets that met the following criteria:

1) Current exceedances of the Groundwater Protection Standard (GWPS)
2) At least six datapoints are available.
3) Greater than 50 percent of detected concentrations are at least 1/10th the applicable Groundwater Protection Standard (GWPS). 1/10th the selenium GWPS (0.05 milligrams per liter [mg/L]) is equal to 0.005 mg/L.

Based on these criteria, locations YGWC-38 and PZ-37 were included in the evaluation. Monitoring location YAMW-5 exhibits selenium concentrations that exceed the GWPS, however, there were too few sample results to meet the 6 datapoint minimum criteria.

The selection of data to include in the statistical evaluation incorporated the criteria listed above, as well as the observed trends developed after closure at these locations. Statistical calculations were completed using all available data, including the most recent 15 sample results for YGWC-38. At PZ-37, two statistical evaluations were completed, one using the entire data set (October 2017 through February 2022) to evaluate plume stability for the tiered MNA evaluation and the other using a truncated dataset tailored to the observed decreasing selenium concentrations in recent years after closure (September 2018 through February 2022) for predictions of time to reach groundwater protection standards.

The Mann-Kendall trend test was completed using the guidelines in Gilbert (1987) and GSI Environmental (2012). The Mann-Kendall trend test is a nonparametric test that determines trend based on ranked data. As such, it is relatively insensitive to small datasets, outlier values, and non-detect concentrations, and does not require the data to fit a specific model. The basic Mann-Kendall trend test is performed by listing the concentrations of the constituent of interest in temporal order and computing the differences between a given measurement and earlier measurements (Gilbert 1987; USEPA 2009). Based on USEPA guidance, non-detect values are set to one value less than that of any detections (USEPA 2009). For this analysis, non-detect values were set to 50 percent of the lower of the lowest detected value or reporting limit. The Mann-Kendall test statistic (sum of trend [S]) is the difference between the number of strictly positive differences and the number of strictly negative differences. If S is positive, an increasing trend is indicated; if S is negative, a decreasing trend is indicated; and if S is near zero, no trend is apparent. The coefficient of variation (CV) is a quantitative measure that can be used to evaluate if concentrations are stable in cases where a statistically significant trend is not apparent. Based on the probability values and coefficient of variation, trends are classified as follows (GSI 2012, Aziz et al 2003):

- Probability >95% = increasing or decreasing
- Probability > 90% = Probably increasing or probably decreasing
- Probability < 90% and S > 0 = no trend
- Probability < 90% and S $\leq$ 0 and CV $\geq$ 1 = no trend
- Probability < 90% and CV < 1 = stable

Where a statistically significant decreasing trend was determined, Sen's slope estimates were used to project a range of years, based on the lower confidence limit and upper confidence limits at confidence level of 90 percent.

Summary statistics and Mann-Kendall trend analysis results are presented in **Attachment A**. Mann-Kendall trend charts are presented in **Attachment B**.

RESULTS

Selenium concentrations at monitoring location YGWC-38 are statistically significant decreasing at 90 percent confidence, based on Mann-Kendall trend analysis. At PZ-37, the entire dataset (October 2017 through February 2022) was stable. Using a truncated dataset over the time period when concentrations of selenium and other CCR constituents began to decrease over time as a result of closure measures (September 2018 through February 2022), a statistically significant decreasing trend was determined.

Sen's slope calculations were completed where a statistically significant decreasing trend was determined; at YGWC-38 and PZ-37 (September 2018 through February 2022). Based on the Sen's slope estimates, selenium concentrations are projected to achieve the GWPS within the following timeframe:

- YGWC-38: within 1 to 2 years, i.e., between 2022 and 2023
- PZ-37: within 2 to 6 years, i.e., between 2023 and 2028

Concentrations of selenium at YAMW-5 were not incorporated into the statistical evaluation.

REFERENCES

Aziz, J.j, Ling, M. Rifai, H.S., Newell, C.J., and J.R. Gonzales. 2003. Groundwater, 40(30): 355-367.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. John Wiley and Sons, Inc. New York.

GSI Environmental. 2012. Software User's Manual, GSI Mann-Kendall Toolkit, for Constituent Trend Analysis. Version 1.

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities. Office of Resource Conservation and Recovery. Unified Guidance. EPA 530-R-09-007.

ATTACHMENTS

Attachment A – Summary Statistics and Mann-Kendall Results

Attachment B – Mann-Kendall Trend Charts

Attachment A

Summary Statistics and Mann-Kendall Results

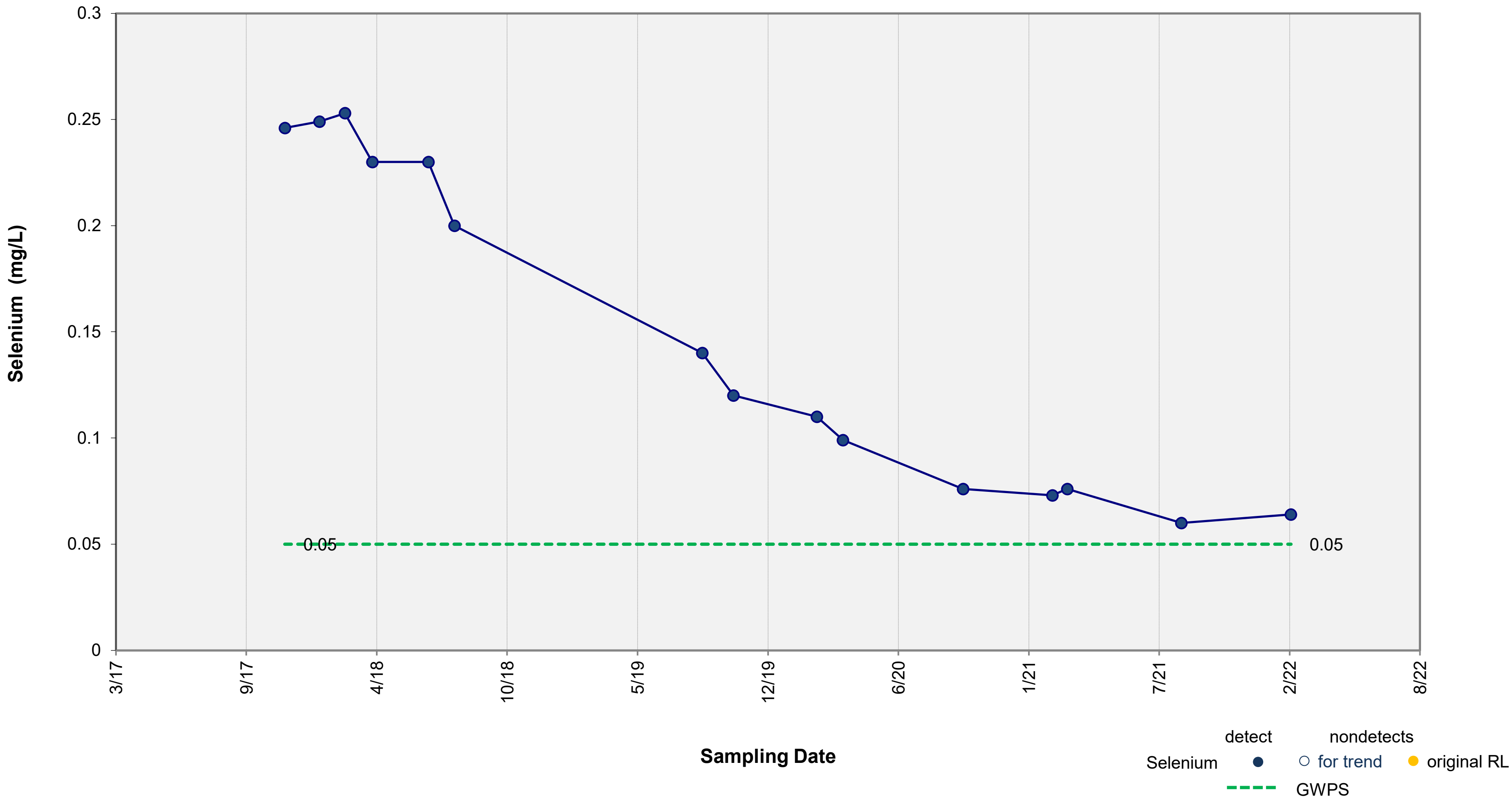
Attachment A. Summary Statistics and Mann-Kendall Results
Plant Yates, Georgia Power Company

Monitoring Well	Constituent	GWPS (mg/L)	Start Date	End Date	n	Minimum Concentration (mg/L)	Maximum Concentration (mg/L) [1]	Most Recent Concentration (mg/L)	% Detect	CV	Mann-Kendall Analysis: S-Statistic	p-value	Trend Direction	Statistical Significance	Sen's Slope Estimates [2]: 90% LCL	Median	90% UCL	Projected Year to GWPS
YGWC-38	Selenium	0.05	11/20/2017	2/10/2022	15	0.06	0.25	0.06	100	0.5	-93	< 0.01	Decreasing	Significant	-1.7E-04	-1.5E-04	-1.2E-04	2022 - 2023
PZ-37	Selenium	0.05	10/12/2017	2/10/2022	13	0.17	0.33	0.2	100	0.2	-4	0.427	Stable		----	----	----	----
PZ-37	Selenium	0.05	9/24/2018	2/10/2022	6	0.2	0.33	0.2	100	0.2	-14	0.005	Decreasing	Significant	-3.9E-04	-2.2E-04	-7.5E-05	2023 - 2028

Notes:
n = number of samples included in analysis
% = percent
CV = coefficient of variation; low values indicate stable concentrations. Values near or greater than 1 suggest variability and/or a temporal trend. Non-detect values were taken at the RL for CV calculations.
GWPS = groundwater protection standard
LCL = lower confidence limit
mg/L = milligrams per liter
UCL = upper confidence limit
---- = not calculated
[1] For datasets where the maximum concentration is a non-detect value, the maximum detected value is presented in brackets [].
[2] Sen's Slope estimates shown for statistically significant decreasing trends.

Attachment B

Mann-Kendall Trend Charts



Results of Mann-Kendall Test for Trend: **DECREASING TREND**

p value = <0.001 Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).

Results of Sen's Estimator of Slope: **DECREASING TREND**

Median Slope Estimate = -1.5E-04 mg/L Per Day

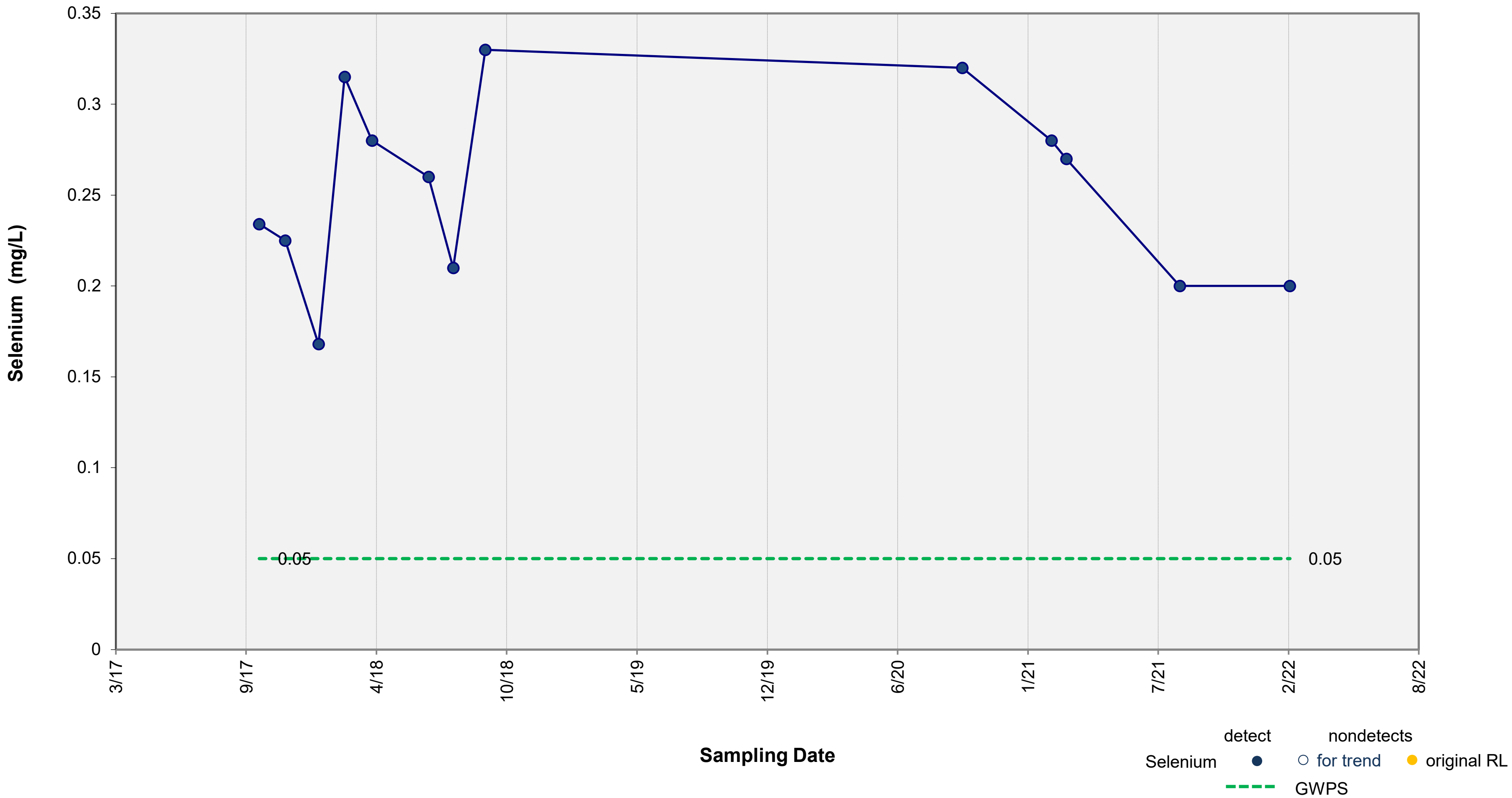
90% Confidence Interval = -1.7E-04 to -1.2E-04 mg/L Per Day

ARCADIS

Concentration vs. Time Plot - Selenium in YGWC-38

Pant Yates, Georgia Power Company

Figure B-1



Results of Mann-Kendall Test for Trend: **Stable**

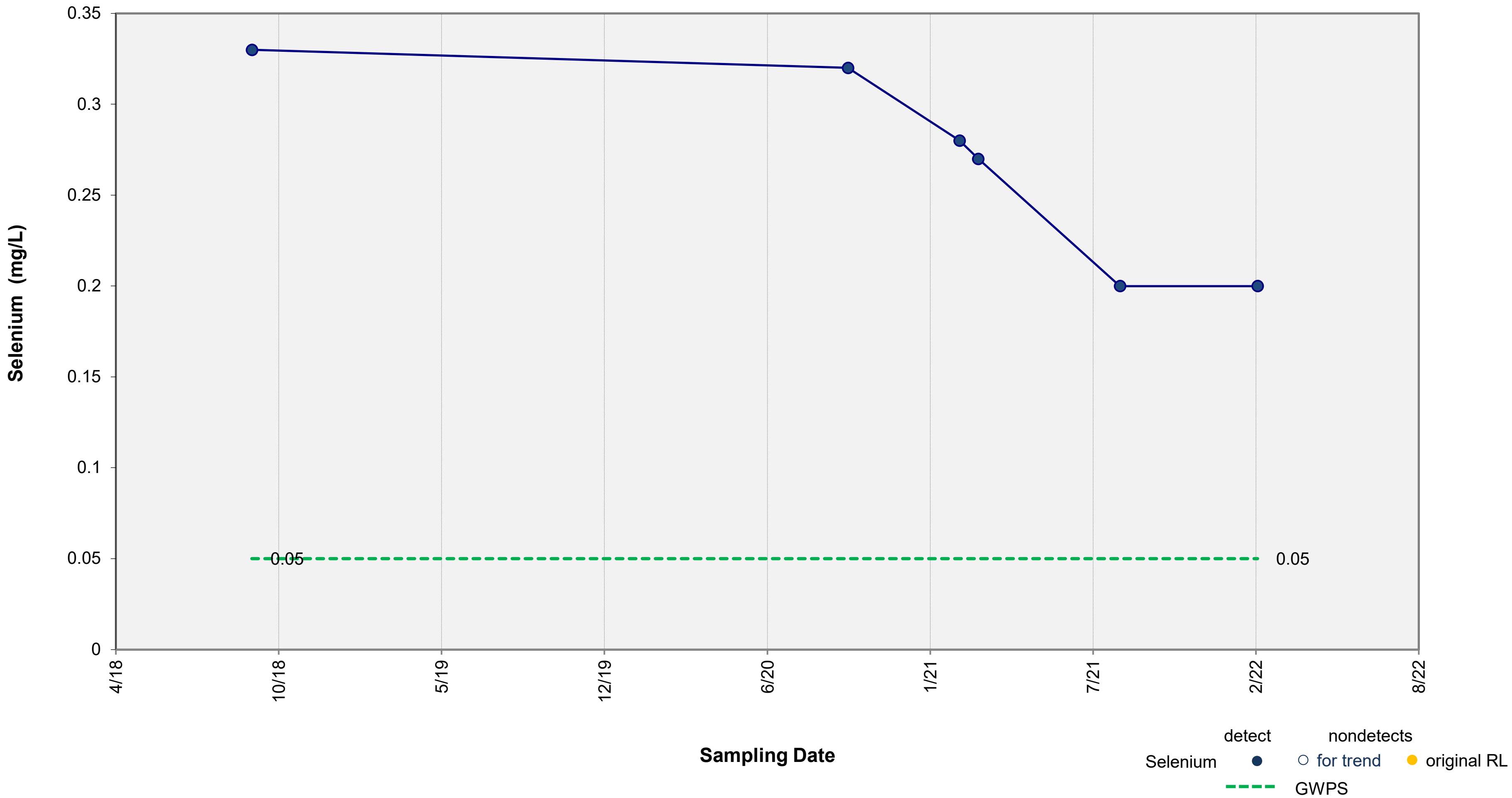
p value = 0.427 Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).

ARCADIS

Concentration vs. Time Plot - Selenium in PZ-37

Pant Yates, Georgia Power Company

Figure B-2



Results of Mann-Kendall Test for Trend: **DECREASING TREND**

p value = 0.005 Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).

Results of Sen's Estimator of Slope: **DECREASING TREND**

Median Slope Estimate = -2.2E-04 mg/L Per Day

90% Confidence Interval = -3.9E-04 to -7.5E-05 mg/L Per Day

ARCADIS

Concentration vs. Time Plot - Selenium in PZ-37

Pant Yates, Georgia Power Company

Figure B-3

Appendix F

Site Specific Demonstration of Natural Attenuation

Appendix F
Site Specific Demonstration of Natural Attenuation

This appendix provides the supporting technical information to demonstrate the progressive evaluation of Monitored Natural Attenuation (MNA) at the Plant Yates R6 CCR Landfill, using the framework established by the U.S. Environmental Protection Agency (USEPA) guidelines for MNA (USEPA 2007, 2015). In 2007, the USEPA issued MNA technical guidance specific to inorganic constituents (USEPA 2007) that contained four “tiers.” The 2015 MNA guidance retains these four “tiers,” but describes them as “phases” as described below (USEPA 2015). Characterization activities were completed to evaluate the existing and long-term effectiveness of attenuation processes in the aquifer and reduce uncertainty for decision making at each of the following screening steps (i.e., phase):

- Phase I: Demonstration that the groundwater plume is *not expanding*.
- Phase II: Determination that the *mechanism and rate* of the attenuation process are sufficient.
- Phase III: Determination that the *capacity* of the aquifer is sufficient to attenuate the mass of contaminant within the plume and the *stability* of the immobilized contaminant is sufficient to resist remobilization.
- Phase IV: Design of a *performance monitoring program* based on an understanding of the mechanism of the attenuation process, and establishment of contingency remedies tailored to site-specific characteristics.

Each phase of the MNA analysis for the site is discussed further below. Supporting data and interpretations from the geochemical CSM (**Appendix B**) are incorporated to demonstrate the site-specific conditions that favor the attenuation of selenium in the R6 CCR Landfill aquifer materials.

Phase I: Stable and Decreasing Concentrations

Phase I of the evaluation of MNA as a viable remedy for the site includes the demonstration of groundwater plume stability. Where a groundwater plume is stable and/or decreasing, MNA may be retained as a viable remedy, as demonstrated by selenium concentrations in the R6 CCR Landfill. Historical and recent groundwater quality (through February 2022) have been evaluated to determine how groundwater is changing as a result of closure.

As demonstrated in Section 3.1, the extent of groundwater with selenium concentrations above the groundwater protection standard (GWPS) has been delineated vertically and horizontally. The stability of the delineated areas is demonstrated through the trend analysis presented in **Appendices B and E**. In the R6 CCR Landfill area, concentrations of target Appendix III indicator constituents (boron, sulfate, and total dissolved solids) have decreased through time on the southeast side of the waste boundary, where selenium SSLs and GWPS exceedances are observed (YGWC-38, PZ-37, and YAMW-5). Selenium concentrations at the R6 CCR Landfill compliance wells are limited to select wells, suggesting that CCR materials placed in some cells leached selenium while others did not and/or leached lesser amounts. Wells that historically exhibited selenium concentrations above the GWPS (YGWC-41, YGWC-38, and PZ-37) have demonstrated decreases since closure of the R6 CCR Landfill was completed in 2016.

To determine whether the observed decreasing selenium concentrations are statistically significant, a Mann-Kendall trend analysis was completed for YGWC-38 and PZ-37 where selenium is above GWPS and there is sufficient data for analysis. YAMW-5 has an insufficient dataset for statistical analysis and was not included. The Mann-Kendall statistical calculations and analysis are detailed in **Appendix E**. The results of the Mann-Kendall analysis showed a statistically significant decreasing trend for concentrations of selenium at YGWC-38. The selenium concentrations were determined to be stable at PZ-37 for the entire dataset (October 2017 through

February 2022). However, using a truncated dataset over the time period when concentrations of selenium began to decrease over time as a result of closure measures (September 2018 through February 2022), a statistically significant decreasing trend was determined.

The observed statistically significant decreasing trends at YGWC-38 and PZ-37 from September 2018 through February 2022 are further supported by the groundwater solute transport model simulations which predict declines in concentrations to less than the GWPS (**Appendix C**). Although an overall trend of decreasing concentrations is observed, it is anticipated that short-term perturbations in groundwater flow and geochemistry due to closure may cause temporary increases in constituent concentrations at some locations, such as selenium at YAMW-5.

Phase II: Mechanism and Rate of Attenuation

Phase II of the MNA evaluation is a determination that the *mechanism and rate* of the attenuation process are sufficient. Mechanisms accounting for the attenuation of selenium at the site include sorption, dilution, and dispersion. Geochemical data also indicates selenium reduction may be a potential mechanism in some portions of the site (**Appendix B**). Under Phase II of the phased MNA evaluation, sufficient attenuation rates to meet the GWPS within a reasonable timeframe must be demonstrated, based on site geochemical conditions (USEPA 2007).

The attenuation mechanism of selenium sorption was evaluated and demonstrated through speciation analysis, general chemical analysis, mineralogical analysis, and sorption studies as detailed in the Geochemical CSM, **Appendix B**. The dominant species of selenium observed at YGWC-38 and YGWC-41 is selenate. Selenate forms outer sphere complexes with aluminum oxides and aluminosilicates; there is also evidence that selenate can form inner sphere complexes on iron oxides, with inner sphere complexes forming at low pH (Peak and Sparks 2002). The mineralogical analysis and drilling observations demonstrated the presence of aluminosilicates (i.e., kaolinite) and iron oxides that serve as sorption surfaces for selenate.

General groundwater chemistry indicates favorable pH and redox conditions for sorption, with mildly acidic site groundwater favoring sorption of both selenite and selenate (Zachara et al. 1994). The presence of elevated sulfate concentrations at YGWC-38, YGWC-41, and PZ-37 inhibits the sorption of selenate through competitive sorption. However, concentrations of sulfate have been declining at the R6 CCR Landfill monitoring wells since closure, allowing for stronger sorption of selenium over time with reduced competition from sulfate (Zachara et al. 1994).

To support the evaluation of attenuation rates for the monitoring locations that exhibit current exceedances of the GWPS, Sen's slope calculations were completed to project a range of years, based on the lower and upper confidence limits at a confidence level of 90 percent, for statistically significant decreasing trends. Based on the Mann-Kendall analysis completed (**Appendix E**), selenium concentrations at YGWC-38 and PZ-37 are decreasing at a statistically significant rate with 90 percent confidence. Sen's slope calculations could not be completed on the full dataset of selenium concentrations at PZ-37, because a statistically significant trend was not established. However, Sen's slope calculations were completed on the truncated dataset for PZ-37, showing the recent (September 2018 through February 2022) statistically significant decline in selenium concentrations. Based on Sen's slope estimates, selenium concentrations are projected to achieve the GWPS within one to two years (between 2022 and 2023) at YGWC-38 and within 2 to 6 years (between 2023 and 2028) at PZ-37. Concentrations of selenium at YAMW-5 were not incorporated into the statistical evaluation; however, concentrations at YAMW-5 are anticipated to decrease after a period of time following closure, similar to YGWC-38 and PZ-37. In addition, the solute transport model predicts that attenuation to concentrations less than the GWPS at the waste boundary will occur by 2032, or approximately 10 years from the date of this report (**Appendix C**).

Phase III: Capacity and Stability of Aquifer Solids

The determination of sufficient attenuation capacity to immobilize the mass of selenium required to GWPS within a reasonable timeframe is the primary goal of the evaluation under Phase III (USEPA 2007). To assess the sorption capacity and stability of the aquifer matrix to attenuate dissolved selenium in groundwater, an aquifer matrix composition analysis and a series of bench-scale sorption tests were completed on the saprolite and bedrock solids (**Appendix B**). Attenuation capacity is supported by results from the mineralogical evaluation, which demonstrated the presence of aluminosilicates (i.e., kaolinite) by x-ray diffraction (XRD). The presence and abundance of aluminum and iron was determined by assay and results suggest a strong potential for secondary aluminum and iron oxides to form during the weathering of saprolite, partially weathered rock, and bedrock (**Appendix B).** These phases, along with kaolinite and other clays, are known to contain attenuation capacity for trace constituents, such as selenium. Sorption capacity was measured in the saprolite and fine-grained bedrock, where the capacity was exceeded (i.e., no measurable sorption observed) when loaded with more than 0.5 milligrams per kilogram (mg/kg) of selenium. When loaded with lower amounts of selenium, the saprolite capacity was 0.008 to 0.13 mg/kg and the fine-grained bedrock capacity was 0.007 to 0.009 mg/kg (**Appendix B**). These estimates likely represent the low end of the range for the site. Sorption at other locations, such as PZ-37, may be higher due to localized lower pH (4.8), low(er) dissolved oxygen conditions, and declining sulfate concentrations, allowing for stronger sorption of selenium with reduced competition from sulfate (Zachara et al. 1994).

Groundwater chemistry over time is the main determinant of whether selenium immobilized onto aquifer solids by natural attenuation processes will remain stable (Su et al., 2007). Immobilization of selenium through sorption at the site is currently favored by mildly acidic groundwater conditions (generally 5 to 7, Appendix B) and inhibited by the presence of elevated sulfate. Sulfate is a competing anion for sorption with selenate. After reaching GWPS via natural attenuation, groundwater conditions are anticipated to remain favorable for selenium sorption, promoting stability. The decreasing sulfate concentrations observed (**Appendix B**) will favor the sorption of selenate over time, as the presence of that competing anion for sorption is reduced. The pH of upgradient water at the R6 CCR Landfill is mildly acidic and will continue to favor sorption of selenate after reaching GWPS.

Phase IV: Performance Monitoring Program

The final phase of the MNA evaluation is the assessment of the long-term performance of the remedy through the development of a performance monitoring program to observe for changes in site conditions and potential alternatives required to attain GWPS (USEPA 2015). A conceptual layout of the source control measures with the MNA groundwater remedy is provided on **Figure 9** of the Draft Remedy Selection Report. The performance monitoring network locations selected will represent adequate spatial (aerial and vertical) distribution of wells to monitor the area(s) impacted by CCR as well as areas in which selenium attenuation is occurring. A finalized list of monitoring locations will be forthcoming in the Corrective Action Groundwater Monitoring Plan, developed following approval of the Remedy Selection Report.

Summary

The site-specific demonstration of natural attenuation at the Plant Yates R6 CCR Landfill followed the USEPA guidance to progressively evaluate and demonstrate the long-term stability and effectiveness of MNA at the site. Using the phased approach, the following conditions were observed:

- Statistically significant decreasing concentrations of selenium at YGWC-38 and PZ-37 from September 2018 through February 2022 (Phase I)
- Favorable pH and redox conditions, in combination with declining sulfate concentrations, support the sorption of selenite and selenate in groundwater. Under the Phase II evaluation, the time to reach selenium concentrations below the GWPS is less than 6 years.
- Capacity for attenuation (Phase III) was demonstrated through mineralogical and assay analysis, which identified clay mineral phases and constituents (aluminum and iron) that are associated with sorption. Sorption studies showed the removal of selenium from solution for the saprolite and fine bedrock fraction.
- The development of a performance monitoring program is forthcoming upon approval of the Remedy Selection Report.

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